TABLE OF CONTENTS OF SPECIAL PROVISIONS

Note: This Table of Contents has been prepared for the convenience of those using this contract with the sole express purpose of locating quickly the information contained herein; and no claims shall arise due to omissions, additions, deletions, etc., as this Table of Contents shall not be considered part of the contract.

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JULY 30, 2014
STATE PROJECT NO. 0431-0006
FEDERAL AID PROJECT NO. CT-90-X523

WATERBURY BUS MAINTENANCE FACILITY REPLACEMENT

Town of Watertown
Federal Aid Project No. CT-90-X523

The State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges and Incidental Construction, Form 816, 2004, as revised by the Supplemental Specifications dated January 2014 (otherwise referred to collectively as "ConnDOT Form 816") Division I, General Requirements and Covenants and Division III, Materials Section; exclusive of references to Method of Measurement and Basis of Payment is hereby made part of this contract, as modified by the Special Provisions contained herein. The State of Connecticut Department of Transportation's "Construction Contract Bidding and Award Manual" ("Manual"), May 14, 2010 edition or latest issue, is hereby made part of this contract. If the provisions of this Manual conflict with provisions of other Department documents (not including statutes or regulations), the provisions of the Manual will govern. The Manual is available upon request from the Transportation Manager of Contracts. The Special Provisions relate in particular to the Construction of a Bus Maintenance Facility in the Town(s) of Watertown.

CONTRACT TIME AND LIQUIDATED DAMAGES

Seven hundred and fifty (750) calendar days will be allowed for completion of the work on this project and the liquidated damages charge to apply will be Nine Thousand One Hundred Dollars ($9,100.00) per calendar day.

NOTICE TO CONTRACTOR – PRE-BID SITE VISIT

A Pre-Bid Site Visit will be held on **August 13, 2014, 10 a.m. at the project site entrance on Route 262 (Frost Bridge Road) in Watertown, Connecticut.**

Work for this Project also involves areas of work that are adjacent to the project site. Therefore, all bidders are strongly encouraged to attend this Pre-Bid Site Visit. There will be no other opportunity afforded to bidders to inspect the Project site.

All attendees must bring hard hats, safety vests, safety glasses, and safety shoes to the site visit. No one will be allowed on the site visit without wearing this safety gear.

Those planning to attend must contact Mr. Philip Melchionne, Contract Section, prior to August 11, 2014, by E-mail to DOTContracts@ct.gov for confirmation. You must provide your name, name of firm, phone number, and number of attendees.

Bidders are advised that no questions will be entertained at the site visit. For all questions you must follow the procedure explained in the special provision entitled "**NOTICE TO CONTRACTOR – PRE-BID QUESTIONS AND ANSWERS**". All questions must be submitted no later than 3:30 PM, Wednesday, August 20, 2014.

NOTICE TO CONTRACTOR – UTILITY GENERATED SCHEDULE

The attached project specific utility work schedule was provided to the Connecticut Department of Transportation (Department) by the utility companies regarding their identified work on this project.

The utility scheduling information is provided to assist the Contractor in scheduling its activities. However, the Department does not ensure its accuracy and Section 1.05.06 of the Standard Specifications still is in force.

The utility scheduling information shall be incorporated into the Contractor's pre-award schedule in accordance with the Department's Bidding and Award Manual and Section 1.05.08 of the Contract.

After award, the Contractor shall conduct a utility coordination meeting or meetings to obtain contemporaneous scheduling information from the utilities prior to submitting its baseline schedule to the Department in accordance with Section (***1.05.08 – Schedules and Reports***) of the Contract.

The Contractor shall incorporate the contemporaneous utility scheduling information into its baseline schedule submittal. The baseline schedule shall include Contractor predecessor and successor activities to the utility work in such detail as acceptable to the Engineer.

rev. 5/20/2013

UTILITY WORK SCHEDULE

CTDOT Project Number:	431-006	Town:	WATERTOWN
Project Description:	WATERBURY BUS MAINTANCE FACILITY		
CTDOT Utilities Engineer:	GREG HENDRICKSON		
Phone:	860-594-3264	Email:	GREGG.HENDRICKSON@CT.GOV
Utility Company:	AT&T		
Prepared By:	BILL GUERRERA	Date Prepared:	5/16/2014
Phone:	203-575-6106	Email:	WG2871@ATT.COM

Scope of Work

The following is a description of all utility work planned to be completed in conjunction with the CTDOT project. The narrative describes all work to be carried out by the utility or its contractor, including temporary and permanent work required by the project as well as any additional utility infrastructure work the utility intends on performing within the project limits during the construction of the project.

PROVIDE COPPER FACILITIES TO NEW BUS MAINTANCE FACILITY. AT&T TO PLACE COPPER IN 4" CONDUIT PROVIDED BY CUSTOMER FROM FROST BRIDGE RD TO NEW FACILITY. A CLEAR PATH FROM OUR EXISTING FACILITIES LOCATED ACROSS THE STREET OF NEW BLDG ON FROST BRIDGE RD MUST BE PROVIDED WITH PULL POINTS LOCATED ROUGHLY EVERY 400'. A BACKBOARD AND GROUND MUST BE PROVIDED IN BLDG FOR MOUNTING OF TERMINAL, IF TERMINAL LOCATION IS MORE THAN 50' INSIDE BLDG A STEEL CONDUIT PATH MUST BE PROVIDED FOR OUR CABLE. AT&T WILL SCHEDULE ITS CONSTRUCTION AS WORK LOADS PERMIT

Special Considerations and Constraints

The following describes the limiting factors that must be planned for in the scheduling and performance of the utility work. For example, restrictions on cut-overs, outages, limitations on customer service interruptions (e.g. nights, weekends, holidays), seasonal and environmental shutdown periods, long lead material procurements, etc..

PLEASE NOTE THAT ANY TIME FRAME GIVEN, START TIME OR DURATION OF WORK CAN BE AFFECTED BY THE DOT CONTRACTOR, OTHER UTILITIES, INCLEMENT WEATHER, STORM RECOVERY, AT&T'S WORKLOAD, HOLIDAYS AND OTHER EMERGENCY SITUATIONS. THIS IS A FORCAST OF CONSTRUCTION DAYS REQUIRED AND IS NOT INTENDED TO BE A SCHEDULE.

UTILITY WORK SCHEDULE

CTDOT Project Number:	431-006		
Utility Company:	AT&T		
Prepared By:	BILL GUERRERA	Total Calendar Days:	5

Schedule

The following schedule identifies each major activity of utility work in sequential order to be performed by the utility or its contractor. The location of each activity of work is identified by the baseline stationing on the CTDOT plans. All activities identify the predecessor activity which must be completed before a utility work activity may progress. The duration provided is the number of calendar days required to complete the utility work activity based on historical information and production rates.

Location (Station to Station)	Description of Utility Work Activity	Predecessor Activity	Duration (calendar days)
CHH#1 TO BLDG	PLACE APPROX. 550' OF CABLE IN CONDUIT	4" DUCT, CHH'S AND PULL ROPE TO BE PLACED BY CUSTOMER	2
BLDG	PLACE BUILDING TERMINAL	BACKBOARD PLACED ON WALL WHERE CUSTOMER NEEDS TERMINAL WITH A	1
BLDG	SPLICE CABLE PRS NEEDED FOR SERVICE AND TEST	CABLE PLACEMENT	2

rev. 5/20/2013

UTILITY WORK SCHEDULE

CTDOT Project Number:	401-006	Town:	Waterbury
Project Description:	Waterbury Bus Maintenance Facility		
CTDOT Utilities Engineer:	Gregg Hendrickson		
Phone:		Email:	

Utility Company:	CL&P		
Prepared By:	Brian Morgan	Date Prepared:	4/9/2014
Phone:	203-597-4233	Email:	morgabw@nu.com

Scope of Work

The following is a description of all utility work planned to be completed in conjunction with the CTDOT project. The narrative describes all work to be carried out by the utility or its contractor, including temporary and permanent work required by the project as well as any additional utility infrastructure work the utility intends on performing within the project limits during the construction of the project.

Replace pole 5349, set new pole, run primary cables and set new padmount transformer

Special Considerations and Constraints

The following describes the limiting factors that must be planned for in the scheduling and performance of the utility work. For example, restrictions on cut-overs, outages, limitations on customer service interruptions (e.g. nights, weekends, holidays), seasonal and environmental shutdown periods, long lead material procurements, etc..

Before any poles are scheduled to be set fees must be paid. Before any additional pole work, new cable installations and transformer work is scheduled fees must be paid, meter work complete and electrical inspection completed on new customer owned switch gear.

UTILITY WORK SCHEDULE

CTDOT Project Number: 431-006

Utility Company: CL&P

Prepared By: Brian Morgan

Total Calendar Days: 11

Schedule

The following schedule identifies each major activity of utility work in sequential order to be performed by the utility or its contractor. The location of each activity of work is identified by the baseline stationing on the CTDOT plans. All activities identify the predecessor activity which must be completed before a utility work activity may progress. The duration provided is the number of calendar days required to complete the utility work activity based on historical information and production rates.

Location (Station to Station)	Description of Utility Work Activity	Predecessor Activity	Duration (calendar days)
	All CL&P work outlined on sheet 1		11

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UTILITY WORK SCHEDULE

CTDOT Project Number:	401-006	Town:	Watertown
Project Description:	650' Main extension to serve Waterbury Bus Facility		
CTDOT Utilities Engineer:			
Phone:	203-596-3093	Email:	melissa.fuller@nu.com
Utility Company:	Yankee Gas Services Company		
Prepared By:	Keegan Richey	Date Prepared:	5/12/2014
Phone:	203-596-3150	Email:	keegan.richey@nu.com

Scope of Work

The following is a description of all utility work planned to be completed in conjunction with the CTDOT project. The narrative describes all work to be carried out by the utility or its contractor, including temporary and permanent work required by the project as well as any additional utility infrastructure work the utility intends on performing within the project limits during the construction of the project.

220' 6" STL MAIN, AND 430' 6" PL MAIN. BRIDGE CROSSING WITH 2 LOOPS. ENVIRONMENTAL, TRAFFIC CONTROL, AND PERMIT INCLUDED, For service installation: ALL DIGGING IN UNPAVED LOT ON CUSTOMER PROPERTY NO ENVIRONMENTAL, TRAFFIC CONTROL, PERMIT, OR RESTORATION NEEDED-INSTALL METER-STATE OF OF CT WILL PROVIDE TRENCHING SAND PADDING AND BACKFILLING ON PROPERTY

Special Considerations and Constraints

The following describes the limiting factors that must be planned for in the scheduling and performance of the utility work. For example, restrictions on cut-overs, outages, limitations on customer service interruptions (e.g. nights, weekends, holidays), seasonal and environmental shutdown periods, long lead material procurements, etc..

A Service Agreement will be presented for approval in first quarter 2015. The Contribution in Aid of Construction is an estimate only and subject to changed and is payable at the time the contract is signed (@$250,000). Meter will be installed and Natrual Gas will be used for temporary heat in 2015.

UTILITY WORK SCHEDULE

CTDOT Project Number:	401-006_Wtby Bus Fac		
Utility Company:	YANKEE GAS SERVICES CO.		
Prepared By:	KEEGAN RICHEY	Total Calendar Days:	46

Schedule

The following schedule identifies each major activity of utility work in sequential order to be performed by the utility or its contractor. The location of each activity of work is identified by the baseline stationing on the CTDOT plans. All activities identify the predecessor activity which must be completed before a utility work activity may progress. The duration provided is the number of calendar days required to complete the utility work activity based on historical information and production rates.

Location (Station to Station)	Description of Utility Work Activity	Predecessor Activity	Duration (calendar days)
rbury Rd. @ Frost Bridg	Install 6" Plastic Pipeline in street.		14
dge over Naugatuck Riv	Install 6" Steel Pipeline on bridge over Naugatuck River.		21
stallation on Bus Facilit	Install 4" Plastic Pipeline from street to meter set at builiding.		10
llation on Side of Bus F	Install Meter set on the side of the bus facility building.		1

NOTICE TO CONTRACTOR – MEASUREMENT AND PAYMENT

This Project is being bid with both lump sum and unit price items. The bid items include unit price and lump sum items which are IN ADDITION TO the Major Lump Sum Item (MLSI) of the Project, Item No. 0100150A, titled "-Maintenance Facility and Item No. 1408801A, titled "Pump Station Building and Equipment". These separate items will be measured for payment on a unit price or lump sum basis (whichever is applicable) for which a separate bid price is required, at the quantities as indicated in the Bid Proposal Form. Each item to be measured is more specifically described in a corresponding Form 816 Standard Specification related to that item, or a special provision, as applicable.

Standard Form 816 Items are referenced by their standard item numbers. Refer to the applicable article of Form 816 for the requirements for this item. Special Provisions included in this Contract are referenced by their item number followed by an "A" suffix. Refer to the Special Provisions contained within this Contract for requirements for this item.

All work depicted on the Contract Plans and described in the Contract Specifications, including mobilization, is included in the MLSI of the Project, with the exception of the unit price or other lump sum items listed in the Bid Proposal Form. Any work incidental to an item which is not specifically described or included in the item, but which is required for performance and completion of the work required under the Contract, is included in the MLSI.

NOTICE TO CONTRACTOR – PRE-BID QUESTIONS AND ANSWERS

Questions pertaining to DOT advertised construction projects must be presented through the CTDOT Pre-Bid Q and A Website. The Department cannot guarantee that all questions will be answered prior to the bid date. **PLEASE NOTE - at 12:01 am, the day before the bid, the subject project(s) being bid will be removed from the Q and A Website, Projects Advertised Section, at which time questions can no longer be submitted through the Q and A Website. At this time, the Q and A for those projects will be considered final, unless otherwise stated and/or the bid is postponed to a future date and time to allow for further questions and answers to be posted.**

If a question needs to be asked the day before the bid date, please contact the Contracts Unit staff and email your question to dotcontracts@ct.gov immediately.

Contractors must identify their company name, contact person, contact email address and phone number when asking a question. The email address and phone number will not be made public.

The questions and answers (if any) located on the Q and A Website are hereby made part of the bid/contract solicitation documents (located on the State Contracting Portal), and resulting contract for the subject project(s). It is the bidder's responsibility to monitor, review, and become familiar with the questions and answers, as with all bid requirements and contract documents, prior to bidding. By signing the bid proposal and resulting contract, the bidder acknowledges receipt of, and agrees to the incorporation of the final list of Q and A, into the contract document.

Contractors will not be permitted to file a future claim based on lack of receipt, or knowledge of the questions and answers associated with a project. All bidding requirements and project information, including but not limited to contract plans, specifications, addenda, Q and A, Notice to Contractors, etc., are made public on the State Contracting Portal and/or the CTDOT website.

NOTICE TO CONTRACTOR – COMMISSIONING RELATED SUBMITTALS

The following submittals requiring Commissioning Authority review for conformance with the Contract shall be clearly labeled "Requires Commissioning Authority Review" on the transmittal when submitted electronically. Hard copies of final approved submittals requiring Commissioning Authority review shall be sent by mail directly to Jacobs, 343 Congress St, 2nd Floor, Boston, MA 02210, Attention: Mr. Mathew Schena. Note that material and product samples are NOT required to be submitted to the Commissioning Authority.

1. Section 07 14 16, "Cold Fluid-Applied Waterproofing"
2. Section 07 16 16, "Crystalline-Applied Waterproofing"
3. Section 07 21 00, "Thermal Insulation"
4. Section 07 42 13, "Metal Wall Panels"
5. Section 07 27 13, "Modified Bituminous Sheet Air Barriers"
6. Section 07 54 23, "Thermoplastic Polyolefin (TPO) Roofing"
7. Section 07 62 00, "Sheet metal flashing and trim"
8. Section 07 71 00, "Roof Specialties"
9. Section 07 72 00, "Roof Accessories"
10. Section 07 92 00, "Joint Sealants"
11. Section 07 95 00, "Expansion Control"
12. Section 08 11 13, "Hollow Metal Doors and Frames"
13. Section 08 11 19, "Stainless Steel Doors and Frames"
14. Section 08 12 16, "Aluminum Frames"
15. Section 08 31 13, "Access Doors and Frames"
16. Section 08 33 00, "Overhead Coiling Doors"
17. Section 08 34 63, "Detention Doors and Frames"
18. Section 08 36 13, "Sectional Doors"
19. Section 08 41 13, "Aluminum Framed Entrances and Storefronts"
20. Section 08 44 13, "Glazed Aluminum Curtain Walls"
21. Section 08 56 53, "Security Windows"
22. Section 08 62 00, "Unit Skylights"
23. Section 08 71 00, "Door Hardware"
24. Section 08 80 00, "Glazing"
25. Section 08 88 53, "Security Glazing"
26. Section 08 91 19, "Fixed Louvers"
27. Section 22 05 33, "Heat Tracing for Plumbing Piping"
28. Section 22 11 16, "Domestic Water Piping"
29. Section 22 11 43, "Facility Packaged Sewage Pumping Stations"
30. Section 22 33 00, "Electric, Domestic Water Heaters"
31. Section 23 09 00, "Instrumentation and Control for HVAC"
32. Section 23 09 93, "Sequence of Operation"
33. Section 23 21 13, "Hydronic Piping"
34. Section 23 21 23, "HVAC Pumps"
35. Section 23 23 00, "Refrigerant Piping"

36. Section 23 31 13, “Metal Ducts”
37. Section 23 33 00, “Duct Accessories”
38. Section 23 34 00, “Fans”
39. Section 23 36 00, “Air Terminals”
40. Section 23 52 16, “Condensing Boilers”
41. Section 23 72 00, “Air-To-Air Energy Recovery Equipment”
42. Section 23 75 23, “Rooftop Heating and Cooling Units”
43. Section 23 81 26, “Ductless Split-System Air Conditioners”
44. Section 23 82 00, “Terminal Units”
45. Section 23 83 16, “Hydronic Radiant Heating Systems”
46. Section 26 09 23, “Lighting Control Equipment”
47. Section 26 32 13, “Engine Generator Systems”
48. Section 26 36 00, “Transfer Switches”

NOTICE TO CONTRACTOR – COMMISSIONING

The Contractor is hereby notified that this project contains a scope for Commissioning described in this section. The Contractor shall bid accordingly.

General: Commissioning consists of systematically documenting that specified components and systems have been installed and started up properly and then functionally tested to verify and document proper operation through all sequences of operation and conditions. In addition, training of the Owner's Operations Personnel will be verified and final project O&M Documents will be reviewed for completeness.

Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions, other Specification Sections and Notice to Contractor Sections, apply to this Section. Specific sections include:

1. NOTICE TO CONTRACTOR – COMMISSIONING RELATED SUBMITTALS for identification of systems that require submittal review by the Commissioning Authority.
2. NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for identification of systems that require Operation and Maintenance Manual submittals and Operator Training.
3. Section 07 08 00 – "Commissioning of Thermal and Moisture Protection" for identification of Commissioned building envelope systems and procedures.
4. Section 08 08 00 – "Commissioning of Openings" for identification of Commissioned building envelope systems and procedures.
5. Section 22 08 00 – "Commissioning of Plumbing" for identification of Commissioned plumbing systems and procedures.
6. Section 23 08 00 – "Commissioning of HVAC" for identification of Commissioned HVAC systems and procedures.
7. Section 26 08 00 – "Commissioning of Electrical Systems" for identification of Commissioned electrical systems and procedures.

Systems to be Commissioned:

1. Mechanical Systems:
    a. Air to Air Energy Recovery Ventilators
    b. Rooftop Heating and Cooling Units
    c. Fans
    d. Air Terminal Units
    e. Boilers
    f. Pumps
    g. Terminal Units
    h. Radiant Heating
    i. Ductless Split System Air Conditioners

j. Building Automation System

2. Plumbing Systems:
   a. Domestic Hot Water System
   b. Sewage Ejector Pumps
3. Electrical Systems:
   a. Lighting Control Equipment
   b. Emergency Power Systems
   c. Building Automation System
4. Building Envelope
   a. Fluid Applied Waterproofing
   b. Crystalline Applied Waterproofing
   c. Fabricated Metal Wall Panel Systems
   d. Roofing System (TPO system)
   e. Metal Doors and Frames (both Hollow Metal and Stainless Steel)
   f. Aluminum Framed Entrances and Storefronts
   g. Glazed Aluminum Curtain Walls
   h. Skylight Systems
   i. Louvers and Vents

Definitions:

1. Basis of Design Document: A document that records the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
2. Commissioning Authority: An entity identified by the Owner who plans, schedules, and coordinates the Commissioning Team to implement the Commissioning Process.
3. Commissioning Plan: Prepared and updated by the Commissioning Authority, the Commissioning Plan outlines the organization, schedule, allocation of resources, and documentation requirements of the Commissioning Process.
4. Commissioning Process: A quality-focused process for enhancing the delivery of a project. The Process focuses on verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner's Project Requirements.

   Commissioning is typically abbreviated by "Cx". Commissioning and Cx have the exact same meaning and will be used interchangeably throughout the Contract documents.
5. Commissioning Team: The individuals who through coordinated actions are responsible for implementing the Commissioning Process.
6. Construction Checklist: Documents prepared by the Cx Authority and issued to the Contractor early in the Construction Phase. The purpose of the Checklist is to verify that

appropriate components are on site, correctly installed and functional & ready for Performance Testing.

7. Corrective Issue Report: A report generated by the Cx Authority during Verification Testing documenting deficiencies found during the testing procedures.
8. Functional Performance Testing: The process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the Owner's Project Requirements.
9. Owner's Project Requirements: A written document that details the functional requirements of a project and the expectations of how it will be used and operated. This includes project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.

Commissioning Team: The Commissioning Team shall consist of a minimum of one (1) Representative for each of the following:

1. Owner.
2. Construction Manager.
3. Designer.
4. Contractor.
5. Commissioning Authority.

Each Commissioning Team Representative shall have at least five (5) years experience in construction administration along with a thorough understanding of construction project documentation procedures.

Each Cx Team Representative shall be familiar with ASHRAE Guideline 0 – The Commissioning Process.

Verification Testing Equipment and Instruments: Contractor shall provide all tools, instruments, laptop computers, PDA's, software programs and services required to perform system Verification Testing procedures. This includes providing the connection to systems to be tested, operation of the test equipment & instrumentation and generating test results as required.

Project Schedule: The Commissioning Authority will provide to the Contractor a Schedule in CPM format identifying the Cx Activities for the Project. The Contractor shall incorporate these Cx Activities into the Master Project Schedule. The Cx Authority will review and update Cx Activities along with the Contractor's Master Schedule Update. Refer to a sample Cx Schedule at the end of this Section.

Submittals / Shop Drawings:
Refer to NOTICE TO CONTRACTOR – COMMISSIONING RELATED SUBMITTALS for Submittals requiring review by the Cx Authority, and directions on how to send the Submittals.

The Commissioning Authority will review Product Submittals and Shop Drawings within the same review period as the Designer. The Cx Authority will review the Submittals and Shop Drawings for Cx Process related information and issue review comments directly to the Designer within 14 days.

The Designer will return one (1) stamped copy of the Commissioning related Submittal / Shop Drawing to the Cx Authority.

Request For Information:
Contractor shall provide one (1) copy of each Commissioning related Request for Information (RFI) to the Cx Authority at the time of submission to the Designer. Reference NOTICE TO CONTRACTOR – COMMISSIONING RELATED SUBMITTALS to determine which RFI's are Commissioning related.

The Commissioning Authority will review each RFI for Commissioning related information and issue any comments directly to the Designer.

Designer will return one (1) answered copy of the RFI to the Cx Authority.

Commissioning Progress Meetings:
The Commissioning Authority will conduct periodic Cx Progress Meetings throughout the construction phase of the project. Commissioning Team Members are required to attend these meetings.

The purpose of conducting Cx Progress Meetings separate from the regular job progress meetings is to focus on the Commissioning Process activities status, schedule and issues. Reference sample Cx Progress Meeting Agenda at the end of this Section.

The Cx Progress meetings shall include, but not be limited to:

1. Commissioning Kick-off Meeting – 1 meeting (shortly after Pre-construction Meeting)
2. Commissioning Progress Meeting – Number of meetings TBD
3. Testing / Training Meeting – 2 Meetings

The Cx Progress Meetings shall be held at the Contractors Field Office.

The Cx Authority will conduct these meetings, record meeting minutes, and distribute the minutes to all attendees with copies to appropriate entities.

Quality Assurance Testing:
Contractor Field Testing: The Commissioning Authority will receive one (1) copy of ALL Test Reports from the Contractor and assemble for record into the Commissioning Systems Manual.

Independent Testing: The Commissioning Authority will receive one (1) copy of ALL Independent Testing Reports from the Contractor and assemble for record into the Commissioning Systems Manual.

Witnessing of Testing by Cx Authority: Commissioning Authority shall be notified a minimum three (3) work days in advance of any Field or Independent Testing being performed. The Cx Authority may or may not decide to witness the test.

Substantiating System Readiness:
The Commissioning Authority will prepare and issue to the Contractor a Construction Checklist Form for each system or major piece of equipment to be Commissioned. Reference sample Construction Checklist at the end of this Section.

The Contractor shall complete each Construction Checklist Form, provided by the Cx Authority, as follows:

1. Complete Section 01 "Equipment Delivery" of the Construction Checklist and forward to the Cx Authority within seven (7) calendar days after equipment delivery to the site.
2. Complete Section 02 "Equipment Installation" of the Construction Checklist and forward to the Cx Authority within seven (7) calendar days after the equipment installation is completed.
3. Complete Section 03 "Equipment Start-up" of the Construction Checklist and forward to the Cx Authority within seven (7) calendar days after the equipment has been successfully started.
4. Complete Section 04 "Notification for Testing" of the Construction Checklist and forward to the Cx Authority within seven (7) calendar days after the equipment is fully operational and ready for Functional Performance Testing.

The Commissioning Authority will monitor and track the completion of the Construction Checklist Forms.

Operation & Maintenance Data:
The Commissioning Process has special requirements on compiling and submitting Operation and Maintenance Data. O&M Data are required to be submitted to the Cx Authority immediately after receipt of the approved submittal from the Designer.

The Cx Authority will compile this information into the Project "Systems Manual" which will be used during Training Sessions.

Operation & Maintenance Data must be submitted and approved before any Owner Training sessions will be allowed.

Functional Performance Testing:
The Commissioning Authority will develop the Functional Performance Test Procedures to be used on the systems being Commissioned. The Test Procedures will be submitted to the

Contractor in advance of scheduled Performance Testing to give the Contractor and Subcontractors time to review the Procedures and make comments or suggest revisions. Reference sample Functional Performance Test Procedure Form at the end of this Section.

The Commissioning Authority will oversee and document results of all Functional Performance Testing Procedures required for equipment and systems to be Commissioned.

The Contractor is required to provide all testing instruments and all skilled labor required to conduct the Functional Test Procedures. The Commissioning Authority will attend all Functional Test Procedures and record all results of the Testing on the Functional Test Procedure Form.

Corrective Issue Reports:
The Commissioning Authority will document deficiencies discovered during Functional Performance Testing of systems on a Corrective Issue Report. The Cx Authority will then forward this form to the Contractor for action in correcting the deficiency.

When the deficiency has been corrected, the Contractor shall note action taken and return the Corrective Issue Report to the Commissioning Authority. Reference sample Corrective Issue Report at the end of this Section.

Corrective Issue Reports must be completed as a pre-requisite for Substantial Completion.

Owner Training:
All training sessions shall be coordinated through the Commissioning Authority. The Cx Authority will prepare a Training Form for each Training Session required by the Contract Documents and issue to the Contractor. The Training Forms shall be used to schedule, perform and document the required training sessions. Reference a sample form at the end of this Section.

After each Training Session is completed, the Cx Authority will issue an Evaluation Form to each of the Attendees. This feedback information will be provided to the Owner and Architect for review. Reference a sample Evaluation Form at the end of this Section.

Refer to NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS for Owner training requirements.

Sample Commissioning Forms: The following forms are provided for use during the testing and commissioning process:

1. Commissioning Progress Meeting Agenda (Figure 1)
2. Construction Checklist (Figure 2)
3. Functional Performance Test Procedure (Figure 3)
4. Corrective Issue Report (Figure 4)
5. Operation and Maintenance Training Form (Figure 5)
6. Training Evaluation Form (Figure 6)

7. Commissioning Schedule (Figure 7)

Meeting:	**Cx Progress # 03**	**Project:**	**New Haven Rail Yard**
Meeting Date:			
Location:	**Job Site Trailer**	**Project No:**	**F9W93200**

Contract Start Date:	June 24, 2003	% Time Elapsed:	36%
Original Completion Date:	December 3, 2004	% Cost Completed:	32%
Approved Extension:	0 Days		
Revised Completion Date:	December 3, 2004		

DISCUSSION:

I. OLD BUSINESS:

II. REVIEW OF ACTION ITEMS:

III. NEW BUSINESS:

A. Schedule Status:

B. RFI Status:

C. Submittal Status:

D. Shop Drawing Status:

EXAMPLE

Figure 1– Cx Progress Meeting Agenda

E. Construction Checklist Status:

F. Functional Performance Testing:

G. O&M Manuals / As Built Drawings:

H. Corrective Issue Reports:

I. Owner Training:

J. Safety:

K. Comments:

1. Owner:

2. Engineer:

3. Contractor:

IV. NEXT MEETING – XXX XX, XXXX

EXAMPLE

Figure 1 (continued) – Cx Progress Meeting Agenda

PROJECT: New Haven Rail Yard

PROJECT NUMBER: F9W93200

REPORT ID: CC-003

EQUIPMENT DESCRIPTION: Fan Powered Terminal Unit

MANUFACTURER: Trane MODEL NO: _____

TAG NO: FPB-1 SERIAL NO: _____

LOCATION: Ceiling Space AREA SERVED:

This Construction Checklist is used during the Commissioning Process to insure the correct equipment is delivered, installed and properly started in preparation for Functional Testing of related building systems. This checklist does not take the place of the Manufacturer's recommended checkout and startup procedures.

This Checklist is divided into 4 Sections and is to be completed by the Contractor in 4 separate steps. As each Section is completed, the Contractor shall mail, fax or e-mail the completed Section(s) to the Commissioning Authority at this address:

Jacobs
343 Congress St
Boston, MA 02210
Attn: Rob Bucey
Phone: 617-963-3039 Fax: 617-242-9824
E-mail: Robert.Bucey@jacobs.com

EXAMPLE

When completing each Section, be sure to check and initial EACH line item as being completed. Immediately notify the Commissioning Authority should any item be checked incomplete or there be any question regarding the level of completeness. Each Section's items must ALL be checked complete and initialed before the form is mailed to the Commissioning Authority.

Figure 2 – Construction Checklist

***SECTION 1* – EQUIPMENT DELIVERY:**

The Contractor shall complete Section 1 of this form when the equipment is delivered to the site. The purpose is to record the actual design parameters listed below along with the checklist items as indicated. Should there be any discrepancy between the Actual and the Submitted information, or any item be checked incomplete, the Contractor shall immediately notify the Commissioning Authority.

DESIGN PARAMETERS:

Parameter	Designed	Submitted	Actual
Max Airflow	300 CFM		
Min Airflow	30 CFM		
Inlet Size	8” Dia		
Coil Capacity	12 MBH		
Coil Flow	1 GPM		
Max Noise Rating	25 NC		
Motor HP	1/3 HP		
Voltage	120 V 1 Ph		

CHECKLIST ITEMS:

Initial	Complete	Description
_____	Yes / No	Inspect Unit for physical damage
_____	Yes / No	Proper shipping blocks provided and remain in tact
_____	Yes / No	Operation and maintenance manuals included
_____	Yes / No	Installation instructions included
_____	Yes / No	Warranty information provided
_____	Yes / No	Correct DDC Controller factory mounted in control box
_____	Yes / No	3’0” Mylar sound trap provided
_____	Yes / No	All duct / air openings sealed from dust and debris

EXAMPLE

COMMENTS:

Submitted By: _____ Date: _____

Figure 2 (continued) – Construction Checklist

***SECTION 2* – EQUIPMENT INSTALLATION:**

The Contractor shall complete Section 2 of this form when the installation of the equipment is being performed. The purpose of this Section is to insure the equipment is installed to the Project Design and the Manufacturer's recommendations. Immediately notify the Commissioning Authority should any item be checked incomplete.

CHECKLIST ITEMS:

Initial	Complete	Description
_____	Yes / No	All quality assurance testing complete and reports submitted
_____	Yes / No	Operation and maintenance data provided to Cx Authority
_____	Yes / No	Power supply energized and properly identified
_____	Yes / No	Proper motor overload protection provided
_____	Yes / No	All shipping blocks removed
_____	Yes / No	Fan rotation correct
_____	Yes / No	Unit properly supported by building structure
_____	Yes / No	3 duct diameters of straight ductwork provided at inlet
_____	Yes / No	Unit disconnect switch provided per Code requirements
_____	Yes / No	Mylar sound trap installed on discharge ductwork
_____	Yes / No	Proper access provided to clean coil surface
_____	Yes / No	Proper access provided to control box section
_____	Yes / No	All piping and ductwork accessories installed per drawing details
_____	Yes / No	Air and water balancing devices accessible
_____	Yes / No	BAS monitoring and control points operational

EXAMPLE

COMMENTS:

Submitted By: _____ Date: _____

Figure 2 (continued) – Construction Checklist

***SECTION 3* – EQUIPMENT START-UP:**

The Contractor shall complete Section 3 of this form during the Start-up procedures for the equipment. The purpose of this Section is to document that proper start-up and check-out procedures were completed and documented.

CHECKLIST ITEMS:

Initial	Complete	Description
_____	Yes / No	Power supply providing proper voltage
_____	Yes / No	Motor operating amperage normal
_____	Yes / No	BAS control sequencing fully operational

EXAMPLE

COMMENTS:

Submitted By: _____ Date: _____

***SECTION 4* – NOTIFICATION FOR TESTING:**

This piece of equipment is properly installed, has been properly started up and is operational and ready for performance testing.

COMMENTS:

Submitted By: _____ Date: _____

Figure 2 (continued) – Construction Checklist

PROJECT: New Haven Rail Yard

PROJECT NUMBER: F9W93200

REPORT ID: FPT-001

SYSTEM DESCRIPTION: Roof Top Unit

Date of Test: _____

Design Criteria:

Supply Fan Maximum Air Flow:	7000	CFM
Supply Fan RPM:	1330	RPM
Supply Fan External Static Pressure:	1.5	Inch
Supply Fan Motor Horse Power:	10	HP
Return Fan Maximum Air Flow:	5300	CFM
Return Fan RPM:	898	RPM
Return Fan External Static Pressure:	0.75	Inch
Return Fan Motor Horse Power:	5	HP
Total Cooling:	251	MBH
Sensible Cooling:	180	MBH
Total Heating:	208	MBH

EXAMPLE

Related Documents:

Specification Sections: 230001 – Basic Mechanical Materials and Methods, 230002 – Basic Mechanical Requirements, 262923 – Variable Frequency Drives, 230300 – Mechanical Identification, 230548 – Mechanical Vibration and Seismic Control, 230900 – HVAC Instrumentation and Controls, 233300 – Air Duct Accessories, 230993 – Sequence of Operation, 230593 – Testing, Adjusting, and Balancing, 230800 – Commissioning of HVAC

Drawings: H102, H221

Submittal Data: Buckley Associates, Inc. submittal

DCS Controller Printouts:

Test Equipment Required:

Digital Multimeter	Air Flow Instruments	Digital Pressure Sensor
Laptop Computer	PID Loop Tuning Software	2-way Radios

Figure 3 – Functional Performance Test Procedure

Sequences of Operation:

Energy Recovery Rooftop Units

A. General
   1. Units shall operate on an occupied and unoccupied time schedule to match the airport's hours of operation. ATC Contractor shall coordinate hours with OWNER.
   2. Upon a detection of smoke within the supply air ductwork as sensed by the duct smoke detector, the supply air and exhaust air fans shall fully close, hot water and chilled water valve shall fully close, and the outside air, exhaust air, and bypass air dampers shall fully close. Alarm signal shall be sent to the BMS.
   3. If the supply air and/or exhaust air and/or energy wheel motors fail, an alarm shall be sent to the BMS.

B. Winter Mode
   1. General
      a. RTU's shall operate in winter mode when OA temperature is below 60 deg F (adj).
      b. Chilled water valve shall be fully closed.
   2. Occupied Operation
      a. Outdoor and exhaust air dampers shall be fully open and bypass damper shall be fully closed.
      b. Supply and exhaust fan shall energize and modulate airflow based on static pressure sensor located within the ductwork via the VFD's. Supply and exhaust fans shall be interlocked linearly to provide appropriate airflow based on the maximum and minimum airflow set points shown on the equipment schedules on drawing H-102.
      c. Energy recovery wheel shall modulate via VFD to provide the maximum amount of energy transfer between air streams. Energy recovery wheel shall be controlled by the equipment manufacturer's sequence of operation to work in conjunction with frost protection option. ATC Contractor shall coordinate with equipment manufacturer.
      d. The hot water valve shall modulate to maintain supply air temperature of 60 deg F (adj).
   3. Unoccupied Operation
      a. Outdoor air and exhaust air dampers shall be closed and bypass damper shall be fully opened.
      b. Supply air and exhaust air fans shall be de-energized.
      c. Energy wheel shall be de-energized.
      d. Hot water valve shall fully open.
      e. Freeze protection cycle shall override Unoccupied Operation.

EXAMPLE

Figure 3 (continued) – Functional Performance Test Procedure

4. Freeze Protection Operation
   a. General
      (1) There shall be two freeze stats (FZS-1): one located before the hot water coil and one in between the hot water coil and the chilled water coil (FZS-2).
   b. Occupied Operation
      (1) When FZS-1 senses a temperature of 40 deg F, the hot water coil valve shall fully open and an alarm shall be sent to the BMS.
      (2) When FZS-2 senses a temperature of 35 deg F the hot water coil valve shall remain open, the outdoor air damper shall fully close, exhaust air damper shall close, the exhaust fan shall de-energize and the bypass damper shall fully open. Supply fan VFD shall operate as defined in the summer or winter occupied modes. An alarm shall be sent to the BMS.
   c. Unoccupied Operation
      (1) When FZS-1 senses a temperature of 40 deg F, the hot water coil valve shall fully open, the outdoor air damper shall remain closed, exhaust air damper shall remain closed, the exhaust fan shall remain de-energized, and the bypass damper shall remain open, and an alarm shall be sent to the BMS.
      (2) When FZS-2 senses a temperature of 35 deg F, the hot water coil valve shall remain open, the outdoor air damper shall remain closed, exhaust air damper shall remain closed, the exhaust fan shall remain de-energized, and the bypass damper shall remain open. Signal shall be sent to the respective FPT's to open the primary air dampers to their minimum positions. Supply fan VFD shall operate as defined in the summer or winter occupied modes. An alarm shall be sent to the BMS.

C. Summer Mode
   1. General
      a. RTU's shall operate in summer mode when OA temperature is above 65 deg F (adj).
      b. Hot water valve shall be fully closed.
   2. Occupied Operation
      a. Outdoor and exhaust air dampers shall be fully open and bypass damper shall be fully closed.
      b. Supply and exhaust fan shall energize and modulate airflow based on static pressure sensor located within the ductwork via VFD's. Supply and exhaust fans shall be interlocked linearly to provide appropriate airflow based on the maximum and minimum airflow set points shown on the equipment schedules on drawing H-102.

EXAMPLE

Figure 3 (continued) – Functional Performance Test Procedure

c. Energy recovery wheel shall modulate via VFD to provide the maximum account of energy transfer between air streams. Energy recovery wheel shall be controlled by the equipment manufacturer's sequence of operation. ATC Contractor shall coordinate with equipment manufacturer.

d. The chilled water valve shall modulate to maintain supply air temperature of 55 deg F (adj).

3. Unoccupied Operation

a. Outdoor air and exhaust air dampers shall be closed and bypass damper shall be fully opened.

b. Supply air and exhaust air fans shall be de-energized.

c. Energy wheel shall be de-energized.

d. Chilled water and hot water valve shall fully close.

e. When all associated FPT units for the respective rooftop unit are calling for cooling, supply air fan shall energize and modulate via VFD based on duct static pressure sensor and chilled water coil valve shall modulate to maintain supply air temperature of 65 deg F.

EXAMPLE

Figure 3 (continued) – Functional Performance Test Procedure

Functional Test Procedures:

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	1	Verify system has been operating at stable, normal conditions. Record O/A temp and %RH.	O/A Temp: _____ °F O/A %RH: _____ %RH
		Field Notes:	
	2	Verify adequate access is provided to all components that require periodic maintenance.	Record any problems existing that interfere with equipment access.
		Field Notes:	
ALARMS			
	3	Verify that the specified alarm points are indicated at the BMS front end PC for each listed condition.	Supply Air Smoke Detector: Yes / No Supply Fan Failure: Yes / No Return Fan Failure: Yes / No Energy Wheel Motor Failure: Yes / No Dirty Filter Alarm: Yes / No Freeze Stat 1: Yes / No Set point: _____ °F Freeze Stat 2: Yes / No Set point: _____ °F
		Field Notes:	
	4	Verify RTU-1 is operating in Occupied Mode.	1. Supply and Exhaust fans are modulating to maintain proper air flow. 2. Bypass damper is closed. 3. Hot or Chilled water valve is open to provide correct supply air temperature (depending on season).
		Field Notes:	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	5	Simulate a smoke condition in the supply air ductwork. Coordinate work with local authorities to avoid unnecessary mobilization of emergency responders.	1. Duct smoke detector senses smoke and an alarm is generated at the BMS. 2. Supply air fan de-energizes and outdoor air damper closes. 3. Exhaust air fan de-energizes. 4. Bypass damper remains closed. 5. Hot and chilled water valves close. 6. Alarm is indicated on Fire Alarm Control Panel
		Field Notes:	
	6	Discontinue the simulation of the smoke condition in the supply air ductwork and clear the smoke alarm. Reset alarm at Fire Alarm Control Panel.	1. Duct smoke alarm is cleared at the BMS. 2. Outdoor air damper opens and supply fan is energized. 3. Exhaust fan is energized. 4. Bypass damper remains closed. 5. Hot or chilled water valve opens (depending on season). 6. RTU-1 resumes normal operation.
		Field Notes:	
	7	Switch the local disconnect to the supply air fan to the OFF position.	1. Supply air fan de-energizes and outdoor air damper closes. 2. Exhaust air fan de-energizes and exhaust damper closes 3. Bypass damper opens, energy recovery wheel stops. 4. Hot and chilled water valves close. 5. Supply fan motor failure alarm is generated at the BMS.
		Field Notes:	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	8	Reset the local disconnect to the supply air fan to the ON position.	1. Supply fan motor failure alarm is cleared at the BMS. 2. Outdoor air damper opens and supply fan is energized. 3. Exhaust damper opens and exhaust fan is energized. 4. Bypass damper closes, energy recovery wheel starts. 5. Hot or chilled water valve opens (depending on season). 6. RTU-1 resumes normal operation.
		Field Notes:	
	9	Switch the local disconnect to the exhaust air fan to the OFF position.	1. Exhaust air fan de-energizes, and exhaust air damper closes. 2. Supply air fan de-energizes and outdoor air damper closes. 3. Bypass damper opens, energy recovery wheel stops. 4. Hot and chilled water valves close. 5. Exhaust fan motor failure alarm is generated at the BMS.
		Field Notes:	
	10	Reset the local disconnect to the exhaust air fan to the ON position.	1. Exhaust fan motor failure alarm is cleared at the BMS. 2. Outdoor air damper opens and supply fan is energized. 3. Exhaust air damper opens and exhaust fan is energized. 4. Bypass damper closes, energy recovery wheel starts. 5. Hot or chilled water valve opens (depending on season). 6. RTU-1 resumes normal operation.
		Field Notes:	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	11	Switch the local disconnect to the energy recovery wheel to the OFF position.	1. Energy recovery wheel is de-energized. 2. Exhaust air fan de-energizes, and exhaust air damper closes. 3. Supply air fan de-energizes and outdoor air damper closes. 4. Bypass damper opens, 5. Hot and chilled water valves close. 6. Energy recovery wheel motor failure alarm is generated at the BMS.
		Field Notes:	
	12	Reset the local disconnect to the energy recovery wheel to the ON position.	1. Energy recovery wheel motor failure alarm is cleared at the BMS. 2. Energy recovery wheel is energized. 3. Outdoor air damper opens and supply fan is energized. 4. Exhaust air damper opens and exhaust fan is energized. 5. Bypass damper closes. 6. Hot or chilled water valve opens (depending on season). 7. RTU-1 resumes normal operation.
		Field Notes:	
	13	Simulate a dirty filter condition	1. Dirty filter sensor is tripped and an alarm is generated the BMS indicating that the filters in RTU-1 need to be changed.
		Field Notes:	
	14	Discontinue the simulation of a dirty filter condition.	1. Clear the alarm at the BMS as if the filters were changed. 2. Dirty filter sensor does not trip on. 3. RTU-1 resumes normal operation.
		Field Notes:	
	15	Open the access door to the supply fan compartment.	1. Door interlocking disconnect switch shall shut down RTU-1 and associated VFDs. 2. Outdoor and exhaust air dampers close, bypass damper opens. 3. An alarm indicating RTU-1 failure shall be generated at the BMS.

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
		Field Notes:	
	16	Close the access door to the supply fan compartment and clear the failure alarm at the BMS.	1. Failure alarm is cleared from the BMS. 2. RTU-1 outdoor and exhaust air dampers open, bypass damper closes, fan starts and associated VFDs ramp up to speed. 3. RTU-1 resumes normal operation.
		Field Notes:	
	17	Open the access door to the exhaust fan compartment.	1. Door interlocking disconnect switch shall shut down RTU-1 and associated VFDs. 2. Outdoor and exhaust air dampers close, bypass damper opens. 3. An alarm indicating RTU-1 failure shall be generated at the BMS.
		Field Notes:	
	18	Close the access door to the exhaust fan compartment and clear the failure alarm at the BMS.	1. Failure alarm is cleared from the BMS. 2. RTU-1 outdoor and exhaust air dampers open, bypass damper closes, fan starts and associated VFDs ramp up to speed. 3. RTU-1 resumes normal operation.
		Field Notes:	
WINTER MODE - NORMAL OPERATION			
	19	Verify that Roof Top Unit RTU-1 is OFF and in unoccupied mode. Record current space temp set point	1. Outdoor air damper is closed and bypass damper is fully open. 2. Supply and Exhaust fans are de-energized. 3. Energy recovery wheel is de-energized. 4. Hot water valve is fully open. 5. Chilled water valve is closed.
		Field Notes:	
	20	Reset occupancy schedule to begin in 10 minutes.	1. Step shall simulate a morning warm up where the following pumps shall be energized to warm up system prior to energizing: a. Heat Pumps (lead) b. Hot Water Pumps (lead) c. Dual Temp Water Pumps (lead)

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
		Field Notes:	
	21	Input a global outdoor air temperature of 50°F Wait for RTU-1 to enable in winter occupied mode.	1. In occupied mode, outdoor air damper will open, and by pass damper shall close. 2. Supply fan energizes. 3. Exhaust fan energizes. 4. Energy recovery wheel energizes. 5. Hot water valve modulates to maintain a supply air temperature of 60°F.
		Field Notes:	
	22	Verify that each of the specified parameters is being monitored, and record current set points for each parameter in the Expected Results Column.	Supply Air Temperature: _____°F Supply Air Static Pressure: _____ in WG Supply Fan Input Frequency: _____ Hz Outdoor Air Temperature: _____ °F Outdoor Air Damper Position: _____ % Exhaust Damper Position: _____ % Exhaust Fan Input Frequency: _____ Hz Bypass Air Damper Position: _____ % Hot Water Valve Position: _____ % Chilled Water Valve Position: _____ % Return Air Temperature: _____ °F Chilled Water Valve Position: _____ % Return Chilled Water Temp: _____ °F Hot Water Valve Position: _____ % Return Hot Water Temp: _____ °F Filter Pressure Differential: Yes / No Normal VAV Box Operation: Yes / No
		Field Notes:	
	23	Allow system to achieve equilibrium	1. System achieves equilibrium 2. Record fan speeds, air flows, valve positions and damper positions.

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
		Field Notes: Initial SA Temp SP: _____ °F Supply Fan Speed: _____ RPM Supply Fan CFM: _____ CFM OA Damper Position: _____ % Bypass Damper Position: _____ % RTU-1 Static Pressure: _____ "wg Energy Wheel Speed:_____ RPM	Exhaust Fan Speed: _____ RPM Exhaust Fan CFM: _____CFM Chilled Water Valve Position: _____ % Hot Water Valve Position: _____ % Outdoor Air Temperature: _____°F Return Air Temperature: _____°F
	24	Reset supply air temperature set point up such that the system calls for heating. Allow system to achieve equilibrium.	1. Hot water valve modulates open to adjust to new supply air temperature set point. 2. Energy recovery wheel modulates its speed to maintain maximum energy transfer. 3. Record initial and reset supply air temperature set points, valve positions and damper positions.
		Field Notes: Initial SA Temp SP: _____ °F Supply Fan Speed: _____ RPM Supply Fan CFM: _____ CFM OA Damper Position: _____ % Bypass Damper Position: _____ % RTU-1 Static Pressure: _____ "wg Energy Wheel Speed:_____ RPM	Reset SA Temp SP: _____ °F Exhaust Fan Speed: _____ RPM Exhaust Fan CFM: _____CFM Chilled Water Valve Position: _____ % Hot Water Valve Position: _____ % Outdoor Air Temperature: _____°F Return Air Temperature: _____°F
	25	Reset supply air temperature set point down such that the system no longer calls for heating. Allow system to achieve equilibrium.	1. Hot water valve modulates closed to adjust to new supply air temperature set point. 2. Energy recovery wheel modulates its speed to maintain maximum energy transfer. 3. Chilled water valve remains closed. 4. Record initial and reset supply air temperature set points, valve positions and damper positions.
		Field Notes: Initial SA Temp SP: _____ °F Supply Fan Speed: _____ RPM Supply Fan CFM: _____ CFM OA Damper Position: _____ % Bypass Damper Position: _____ % RTU-1 Static Pressure: _____ "wg Energy Wheel Speed:_____ RPM	Reset SA Temp SP: _____ °F Exhaust Fan Speed: _____ RPM Exhaust Fan CFM: _____CFM Chilled Water Valve Position: _____ % Hot Water Valve Position: _____ % Outdoor Air Temperature: _____°F Return Air Temperature: _____°F

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	26	Reset supply air temperature set point to initial set point. Allow system to achieve equilibrium.	1. Hot water valve modulates to adjust to new supply air temperature set point. 2. Chilled water valve remains closed. 3. Record initial and reset supply air temperature set points, valve positions and damper positions.
		Field Notes: Initial SA Temp SP: _____ °F Supply Fan Speed: _____ RPM Supply Fan CFM: _____ CFM OA Damper Position: _____ % Bypass Damper Position: _____ % RTU-1 Static Pressure: _____ "wg Energy Wheel Speed:_____ RPM	Reset SA Temp SP: _____ °F Exhaust Fan Speed: _____ RPM Exhaust Fan CFM: _____CFM Chilled Water Valve Position: _____ % Hot Water Valve Position: _____ % Outdoor Air Temperature: _____°F Return Air Temperature: _____°F
	27	Command all terminal units to full open such that the supply and exhaust air flows reach their maximum levels. If necessary Increase the static pressure set point for RTU-1. Allow the system to achieve equilibrium.	1. Duct static pressure falls (set point may be increased) and RTU-1 ramps up. 2. Supply and exhaust air flows increase to maximum levels. 3. Energy recovery wheel modulates its speed to maintain maximum energy transfer. 4. Record applicable equipment operating parameters.
		Field Notes: Initial Static Pressure SP: _____ "wg Supply Fan Speed: _____ RPM Supply Fan CFM: _____ CFM OA Damper Position: _____ % Bypass Damper Position: _____ % Supply Air Temperature: _____ °F Energy Wheel Speed:_____ RPM	Reset Static Pressure SP: _____ "wg Exhaust Fan Speed: _____ RPM Exhaust Fan CFM: _____CFM Chilled Water Valve Position: _____ % Hot Water Valve Position: _____ % Outdoor Air Temperature: _____°F Return Air Temperature: _____°F
	28	Command all terminal units to minimum flow such that the supply and exhaust air flows reach their minimum levels. If necessary, decrease the static pressure set point for RTU-1. Allow the system to achieve equilibrium.	1. Duct static pressure increases (set point may be decreased) and RTU-1 ramps down. 2. Supply and exhaust air flows decrease to minimum levels. 3. Energy recovery wheel modulates its speed to maintain maximum energy transfer. 4. Record applicable equipment operating parameters.

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
		Field Notes: Initial Static Pressure SP: _____ "wg Supply Fan Speed: _____ RPM Supply Fan CFM: _____ CFM OA Damper Position: _____ % Bypass Damper Position: _____ % Supply Air Temperature: _____ °F Energy Wheel Speed:_____ RPM	Reset Static Pressure SP: _____ "wg Exhaust Fan Speed: _____ RPM Exhaust Fan CFM: _____CFM Chilled Water Valve Position: _____ % Hot Water Valve Position: _____ % Outdoor Air Temperature: _____°F Return Air Temperature: _____°F
	29	Release any terminal unit override commands, return the static pressure set point to its original value. Allow the system to achieve equilibrium.	1. Static pressure returns to original set point and RTU-1 ramps up slightly. 2. Supply and exhaust fans modulate their speed to provide proper air flows. 3. Record applicable equipment operating parameters.
		Field Notes: Initial Static Pressure SP: _____ "wg Supply Fan Speed: _____ RPM Supply Fan CFM: _____ CFM OA Damper Position: _____ % Bypass Damper Position: _____ % Supply Air Temperature: _____ °F Energy Wheel Speed:_____ RPM	Reset Static Pressure SP: _____ "wg Exhaust Fan Speed: _____ RPM Exhaust Fan CFM: _____CFM Chilled Water Valve Position: _____ % Hot Water Valve Position: _____ % Outdoor Air Temperature: _____°F Return Air Temperature: _____°F
	30	Reset occupancy schedule to end in 5 minutes such that RTU-1 will be in unoccupied mode.	1. Outdoor and exhaust air dampers close. 2. Bypass damper opens fully. 3. Supply air and exhaust air fans are de-energized. 4. Energy recovery wheel is de-energized. 5. Hot water coil valve opens fully.
		Field Notes:	
	31	Simulate a frost condition at Freeze Stat 1 (FZS-1) by either raising the freeze stat set point above current air temperature or spraying the sensor with "freeze spray".	1. A FZS-1 freeze protection alarm shall be generated at the BMS. 2. Hot water coil valve shall remain fully open. 3. Bypass damper remains open 4. All other dampers, fans, and wheels remain closed or off.
		Field Notes:	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	32	Reset the FSZ-1 set point or discontinue the frost condition simulation and allow the system to achieve equilibrium.	1. The FZS-1 freeze protection alarm shall clear from the BMS. 2. Hot water coil valve shall remain fully open. 3. Bypass damper remains open 4. All other dampers, fans, and wheels remain closed or off.
		Field Notes:	
	33	Simulate a frost condition at Freeze Stat 2 (FZS-2) by either raising the freeze stat set point above current air temperature or spraying the sensor with “freeze spray”.	1. A FZS-2 freeze protection alarm shall be generated at the BMS. 2. Hot water coil valve shall remain fully open. 3. Bypass damper remains open. 4. Outdoor air damper remains closed. 5. Exhaust air fan and energy recovery wheel remain de-energized. 6. Fan powered terminal units of RTU-1 open their primary air dampers to their minimum positions. 7. Supply air fan starts and operates to maintain duct static pressure set point.
		Field Notes:	
	34	Reset the FSZ-2 set point or discontinue the frost condition simulation and allow the system to achieve equilibrium.	1. The FZS-2 freeze protection alarm shall clear from the BMS. 2. Hot water coil valve shall remain fully open. 3. Bypass damper remains open. 4. Outdoor air damper remains closed. 5. Exhaust air fan and energy recovery wheel remain de-energized. 6. Fan powered terminal units of RTU-1 shall close their dampers. 7. Supply air fan de-energizes and resumes unoccupied operation.
		Field Notes:	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	35	Perform a manual start up of the RTU such that it will be in occupied mode.	1. In occupied mode, Outdoor air damper will open, and by pass damper shall close. 2. Supply fan energizes. 3. Exhaust fan energizes. 4. Energy recovery wheel energizes. 5. Hot water coil valve modulates to maintain a supply air temperature of 60°F.
		Field Notes:	
	36	Simulate a frost condition at Freeze Stat 1 (FZS-1) by either raising the freeze stat set point above current air temperature or spraying the sensor with “freeze spray”.	1. A FZS-1 freeze protection alarm shall be generated at the BMS. 2. Hot water coil valve shall fully open. 3. Energy recovery wheel ramps down its speed. Record its new speed.
		Field Notes:	
	37	Reset the FSZ-1 set point or discontinue the frost condition simulation and allow the system to achieve equilibrium.	1. The FZS-1 freeze protection alarm shall clear from the BMS. 2. Hot water coil valve modulates to maintain a supply air temperature of 60°F. 3. Energy recovery wheel returns to normal operating speed.
		Field Notes:	
	38	Simulate a frost condition at Freeze Stat 2 (FZS-2) by either raising the freeze stat set point above current air temperature or spraying the sensor with “freeze spray”.	1. A FZS-2 freeze protection alarm shall be generated at the BMS. 2. Hot water coil valve shall fully open. 3. Outdoor air damper closes. 4. Bypass damper shall open. 5. Exhaust air fan shall de-energize. 6. Supply air fan shall operate normally in winter occupied mode. 7. Energy recovery wheel ramps down its speed. Record its new speed.
		Field Notes:	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	39	Reset the FSZ-2 set point or discontinue the frost condition simulation and allow the system to achieve equilibrium.	1. The FZS-2 freeze protection alarm shall clear from the BMS. 2. Hot water coil valve modulates to maintain a supply air temperature of 60°F. 3. Outdoor air damper opens. 4. Bypass damper shall close. 5. Exhaust air fan shall energize. 6. Supply air fan shall continue to operate normally. 7. Energy recovery wheel returns to normal operating speed.
		Field Notes:	
	40	Release all set points and scheduling overrides such that RTU-1 returns to normal operation.	1. RTU-1 resumes normal operation.
		Field Notes:	
SUMMER MODE – NORMAL OPERATION			
	41	Verify that Roof Top Unit RTU-1 is OFF and in unoccupied mode. Record current space temp set point	1. Outdoor air damper is closed and bypass damper is fully open. 2. Supply and Exhaust fans are de-energized. 3. Energy recovery wheel is de-energized. 4. Chilled water valve is closed. 5. Hot water valve is closed.
		Field Notes:	
	42	Reset occupancy schedule to begin in 10 minutes.	1. Step shall simulate a morning warm up where the following pumps shall be energized to warm up system prior to energizing: a. Heat Pumps (lead) b. Dual Temp Water Pumps (lead)
		Field Notes:	

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	43	Input a global outdoor air temperature of 70°F Wait for RTU-1 to enable in summer occupied mode.	1. In occupied mode, outdoor air damper will open, and by pass damper shall close. 2. Supply fan energizes. 3. Exhaust fan energizes. 4. Energy recovery wheel energizes. 5. Chilled water valve modulates to maintain a supply air temperature of 55°F.
		Field Notes:	
	44	Verify that each of the specified parameters is being monitored, and record current set points for each parameter in the Expected Results Column.	Supply Air Temperature: _____°F Supply Air Static Pressure: _____ in WG Supply Fan Input Frequency: _____ Hz Outdoor Air Temperature: _____ °F Outdoor Air Damper Position: _____ % Exhaust Air Damper Position: _____% Bypass Air Damper Position: _____ % Hot Water Valve Position: _____ % Return Hot Water Temp: _____°F Chilled Water Valve Position: _____ % Return Chilled Water Temp: _____°F Filter Pressure Differential: Yes / No Normal VAV Box Operation: Yes / No
		Field Notes:	
	45	Allow system to achieve equilibrium	1. System achieves equilibrium 2. Record fan speeds, air flows, valve positions and damper positions.
		Field Notes: Initial Supply Air Temp: _____ °F Supply Fan Speed: _____ RPM Supply Fan CFM: _____ CFM OA Damper Position: _____ % Bypass Damper Position: _____ % RTU-1 Static Pressure: _____ “wg Energy Wheel Speed:_____ RPM	Exhaust Fan Speed: _____ RPM Exhaust Fan CFM: _____CFM Chilled Water Valve Position: _____ % Hot Water Valve Position: _____ % Outdoor Air Temperature: _____°F Return Air Temperature: _____°F

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
	46	Reset supply air temperature set point down such that the system calls for cooling. Allow system to achieve equilibrium.	1. Chilled water valve modulates open to adjust to new supply air temperature set point. 2. Energy recovery modulates maintain maximum energy transfer. 3. Record initial and reset supply air temperature set points, valve positions and damper positions.
		Field Notes: Initial SA Temp SP: _____ °F Supply Fan Speed: _____ RPM Supply Fan CFM: _____ CFM OA Damper Position: _____ % Bypass Damper Position: _____ % RTU-1 Static Pressure: _____ "wg Energy Wheel Speed:_____ RPM	Reset SA Temp SP: _____ °F Exhaust Fan Speed: _____ RPM Exhaust Fan CFM: _____CFM Chilled Water Valve Position: _____ % Hot Water Valve Position: _____ % Outdoor Air Temperature: _____°F Return Air Temperature: _____°F
	47	Reset supply air temperature set point up such that the system no longer calls for cooling. Allow system to achieve equilibrium.	1. Chilled water valve modulates closed to adjust to new supply air temperature set point. 2. Energy recovery wheel modulates to maintain maximum energy transfer. 3. Hot water valve remains closed. 4. Record initial and reset supply air temperature set points, valve positions and damper positions.
		Field Notes: Initial SA Temp SP: _____ °F Supply Fan Speed: _____ RPM Supply Fan CFM: _____ CFM OA Damper Position: _____ % Bypass Damper Position: _____ % RTU-1 Static Pressure: _____ "wg Energy Wheel Speed:_____ RPM	Reset SA Temp SP: _____ °F Exhaust Fan Speed: _____ RPM Exhaust Fan CFM: _____CFM Chilled Water Valve Position: _____ % Hot Water Valve Position: _____ % Outdoor Air Temperature: _____°F Return Air Temperature: _____°F
	48	Reset supply air temperature set point to initial set point. Allow system to achieve equilibrium.	1. Chilled water valve modulates to adjust to new supply air temperature set point. 2. Hot water valve remains closed. 3. Record initial and reset supply air temperature set points, valve positions and damper positions.

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
		Field Notes: Initial SA Temp SP: _____ °F Supply Fan Speed: _____ RPM Supply Fan CFM: _____ CFM OA Damper Position: _____ % Bypass Damper Position: _____ % RTU-1 Static Pressure: _____ "wg Energy Wheel Speed:_____ RPM	Reset SA Temp SP: _____ °F Exhaust Fan Speed: _____ RPM Exhaust Fan CFM: _____CFM Chilled Water Valve Position: _____ % Hot Water Valve Position: _____ % Outdoor Air Temperature: _____°F Return Air Temperature: _____°F
	49	Command all terminal units to full open such that the supply and exhaust air flows reach their maximum levels. If necessary Increase the static pressure set point for RTU-1. Allow the system to achieve equilibrium.	1. Duct static pressure falls (set point may be increased) and RTU-1 ramps up. 2. Supply and exhaust air flows increase to maximum levels. 3. Energy recovery wheel modulates its speed to maintain maximum energy transfer. 4. Record applicable equipment operating parameters.
		Field Notes: Initial Static Pressure SP: _____ "wg Supply Fan Speed: _____ RPM Supply Fan CFM: _____ CFM OA Damper Position: _____ % Bypass Damper Position: _____ % Supply Air Temperature: _____ °F Energy Wheel Speed:_____ RPM	Reset Static Pressure SP: _____ "wg Exhaust Fan Speed: _____ RPM Exhaust Fan CFM: _____CFM Chilled Water Valve Position: _____ % Hot Water Valve Position: _____ % Outdoor Air Temperature: _____°F Return Air Temperature: _____°F
	50	Command all terminal units to minimum flow such that the supply and exhaust air flows reach their minimum levels. If necessary, decrease the static pressure set point for RTU-1. Allow the system to achieve equilibrium.	1. Duct static pressure increases (set point may be decreased) and RTU-1 ramps down. 2. Supply and exhaust air flows decrease to minimum levels. 3. Energy recovery wheel modulates its speed to maintain maximum energy transfer. 4. Record applicable equipment operating parameters.

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
		Field Notes: Initial Static Pressure SP: _____ "wg Supply Fan Speed: _____ RPM Supply Fan CFM: _____ CFM OA Damper Position: _____ % Bypass Damper Position: _____ % Supply Air Temperature: _____ °F Energy Wheel Speed:_____ RPM	Reset Static Pressure SP: _____ "wg Exhaust Fan Speed: _____ RPM Exhaust Fan CFM: _____CFM Chilled Water Valve Position: _____ % Hot Water Valve Position: _____ % Outdoor Air Temperature: _____°F Return Air Temperature: _____°F
	51	Release any terminal unit override commands, return the static pressure set point to its original value. Allow the system to achieve equilibrium.	1. Static pressure returns to original set point and RTU-1 ramps up slightly. 2. Supply and exhaust fans modulate their speed to provide proper air flows. 3. Record applicable equipment operating parameters.
		Field Notes: Initial Static Pressure SP: _____ "wg Supply Fan Speed: _____ RPM Supply Fan CFM: _____ CFM OA Damper Position: _____ % Bypass Damper Position: _____ % Supply Air Temperature: _____ °F Energy Wheel Speed:_____ RPM	Reset Static Pressure SP: _____ "wg Exhaust Fan Speed: _____ RPM Exhaust Fan CFM: _____CFM Chilled Water Valve Position: _____ % Hot Water Valve Position: _____ % Outdoor Air Temperature: _____°F Return Air Temperature: _____°F
	52	Reset occupancy schedule to end in 5 minutes such that RTU-1 will be in unoccupied mode. Allow the system to achieve equilibrium.	1. Outdoor air damper closes. 2. Bypass damper opens fully. 3. Supply air and exhaust air fans are de-energized. 4. Energy recovery wheel is de-energized. 5. Chilled water coil valve closes. 6. Hot water coil valve remains closed.
		Field Notes:	
	53	Decrease all of the unoccupied cooling temperature set points in the zones served by RTU-1 such that all of the zones call for cooling.	1. Bypass damper remains open and outdoor air damper remains shut. 2. Supply air fan shall energize and modulate via VFD based on duct static pressure. 3. Chilled water coil valve shall open and modulate to maintain supply air temperature of 65°F. 4. Terminal unit dampers shall be fully open.

Pass Y/N	No	TEST PROCEDURE	EXPECTED RESULTS
		Field Notes:	
	54	Reset the unoccupied cooling temperature set points to their original values such that the zone space temperatures are satisfied.	1. Bypass damper remains open and outdoor air damper remains shut. 2. Supply air fan de-energizes and STOPS. 3. Chilled water coil valve closes. 4. RTU-1 resumes normal unoccupied operation.
		Field Notes:	
	55	Perform a manual shutdown of RTU-1.	1. RTU-1 shuts down.
		Field Notes:	
	56	Perform a manual start up of the RTU such that it will be in occupie d mode.	1. In occupied mode, Outdoor air damper will open, and by pass damper shall close. 2. Supply fan energizes. 3. Exhaust fan energizes. 4. Energy recovery wheel energizes. 5. Hot water coil valve modulates to maintain a supply air temperature of 60°F.
		Field Notes:	
	57	Release all set points and scheduling overrides such that RTU-1 returns to normal operation.	1. RTU-1 resumes normal operation.
		Field Notes:	

EXAMPLE

Summary of Results:

CORRECTIVE ISSUES:

Acceptance of Test:

☐ This test cannot be accepted at this time due to the Corrective Issues noted above.

☐ This test is accepted by the Commissioning Authority identified below:

Signed: _____ Date: _____

Commissioning Authority

EXAMPLE

Figure 3 (continued) – Functional Performance Test Procedure

PROJECT: New Haven Rail Yard

PROJECT NUMBER: F9W93200

REPORT ID: CIR-009

SYSTEM OR EQUIPMENT: Chilled Water Pump 3

Description of Deficiency:

Reference:

Issued By: _____ **Date:** _____

Description of Actions Taken:

EXAMPLE

Issued By: _____ **Date:** _____

Verification of Issue Correction:

Verified By: _____ **Date:** _____

Signature: _____

Figure 4 – Corrective Issue Report

PROJECT: New Haven Rail Yard

PROJECT NUMBER: F9W93200

SYSTEM OR EQUIPMENT DESCRIPTION: Fire Pump and Controller

***Section 1:* Training Plan (completed by Contractor):**

_____ A: Suggested dates for Training: Primary Date: _____

Alternate Date: _____

_____ B: Instructor Information: Name: _____

Company: _____

Title: _____

Phone: _____

Fax: _____

Email: _____

_____ C: Time Required: Hours: _____

_____ D: Agenda Attached along with description of Handouts and Materials to be used during the Training Session.

***Section 2:* Approval of Training Session (completed by Jacobs):**

_____ A: Reviewed with Owner and Approved By:

Name: _____

Signature: _____ Date: _____

***Section 3:* Training Session Sign In Record (completed by Attendees during Training Session):**

Name:	Company:	Phone:

***Section 4:* Acceptance of Training Session (completed by Jacobs):**

_____ A: Evaluation Forms Received.

_____ B: Reviewed with Owner and Contractor and Accepted By:

Name: _____

Signature: _____ Date: _____

EXAMPLE

Figure 5 – Operation Training Form

PROJECT: New Haven Rail Yard

PROJECT NUMBER: F9W93200

Training Session: CHILLED WATER SYSTEM

Session Date: Monday, November 28, 2008

Name (optional): _____

This form is to be completed by each person that attended this Training Session.

After completing this Form please return to:

Jacobs
343 Congress St
Boston, MA 02210
Attn: Rob Bucey
Phone: 617.963.3039 Fax: 617.242.9824
E-mail: Robert.Bucey@jacobs.com

EXAMPLE

		1 = Very Well				5 = Not At All	
1.	How were the objectives of this Training Session met?	1	2	3	4	5	N/A
2.	Do you know where the components / systems are located?	1	2	3	4	5	N/A
3.	Do you know what area the components / systems are are serving?	1	2	3	4	5	N/A
4.	Do you understand the various types and purpose of these components / systems?	1	2	3	4	5	N/A
5.	Do you understand how to systematically troubleshoot common problems with these components / systems?	1	2	3	4	5	N/A
6.	Do you know how the components / systems operate under normal modes?	1	2	3	4	5	N/A
7.	How well do you understand the importance of meeting the design intent for the systems covered?	1	2	3	4	5	N/A
8.	Are you able to efficiently find the relevant information in systems manual to operate and maintain the components / systems you were trained for in this session?	1	2	3	4	5	N/A
9.	Do you know how to perform the needed maintenance on the equipment and get the information needed?	1	2	3	4	5	N/A
10.	Do you know how to get updated technical information for the components / systems?	1	2	3	4	5	N/A

Provide any additional comments: _____

_____

Figure 6 – Training Evaluation Form

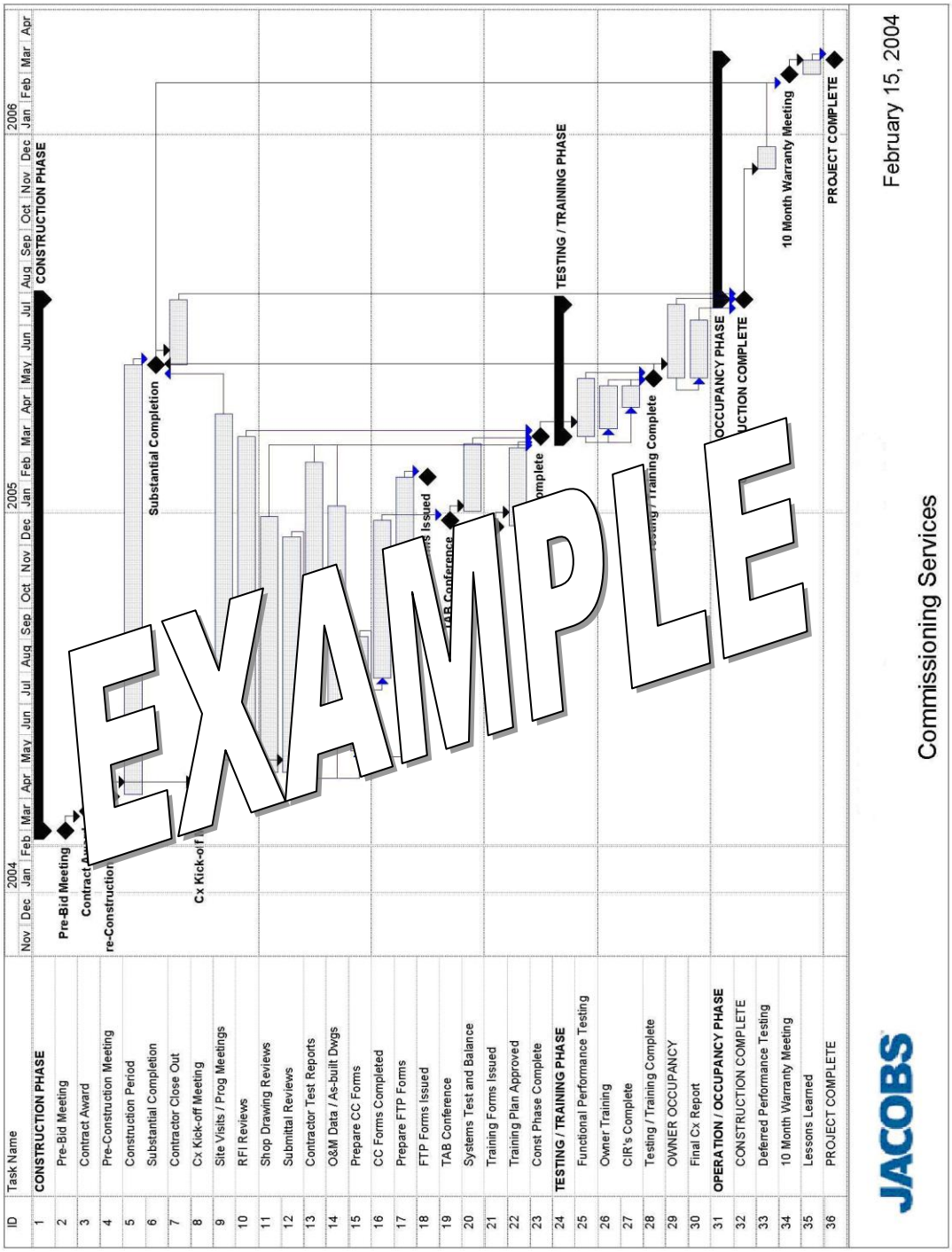

Figure 7 – Sample Commissioning Schedule

NOTICE TO CONTRACTOR – FORM 816 REFERENCES ON STANDARD DRAWINGS

The Contract includes standard Connecticut Department of Transportation drawings with material and pay limit references to Form 816. For work shown on these drawings that is included under the Major Lump Sum Item (MLSI) for the Project, the Contractor shall disregard these references within the Vertical Construction Limits which are defined in Notice to Contractor – Measurement and Payment. Concrete shall comply with the requirements of CSI Specification Section 033000 under the MLSI.

Pay limits for unit price and lump sum items other than the MLSI shall be in accordance with Method of Measurement (Part 4), and Basis of Payment (Part 5) of the appropriate special provision section. Concrete for unit price items other than the MLSI shall be in accordance with Form 816, unless specifically noted otherwise.

NOTICE TO CONTRACTOR - NCHRP 350 REQ. FOR WORK ZONE TRAFFIC CONTROL DEVICES

CATEGORY 1 DEVICES (traffic cones, traffic drums, tubular markers, flexible delineator posts)

Prior to using the Category 1 Devices on the project, the Contractor shall submit to the Engineer a copy of the manufacturer's self-certification that the devices conform to NCHRP Report 350.

CATEGORY 2 DEVICES (construction barricades, construction signs and portable sign supports)

Prior to using Category 2 Devices on the project, the Contractor shall submit to the Engineer a copy of the Letter of Acceptance issued by the FHWA to the manufacturer documenting that the devices (both sign and portable support tested together) conform to NCHRP Report 350 (TL-3).

Specific requirements for these devices are included in the Special Provisions.

Information regarding NCHRP Report 350 devices may be found at the following web sites:

FHWA: http://safety.fhwa.dot.gov/roadway_dept/road_hardware/index.htm

ATSSA: http://www.atssa.com/resources/NCHRP350Crashtesting.asp

NOTE: The portable wooden sign supports that have been traditionally used by most contractors in the State of Connecticut do NOT meet NCHRP Report 350 criteria and shall not be utilized on any project advertised after October 01, 2000.

CATEGORY 3 DEVICES (Truck-Mounted Attenuators & Work Zone Crash Cushions)

Prior to using Category 3 Devices on the project, the Contractor shall submit to the Engineer a copy of the Letter of Acceptance issued by the FHWA to the manufacturer documenting that the devices conform to NCHRP Report 350.

NOTICE TO CONTRACTOR – SCHEDULE OF VALUES FOR MAJOR LUMP SUM ITEMS

The Contractor is hereby notified that separate Schedules of Values must be submitted for the two (2) individual Major Lump Sum Items (MLSI) for this project. The two MLSI for this project are as follows:

Maintenance Facility
Water and Wastewater Facilities

The schedule of values for each site, as noted above, shall be submitted in accordance with Form 816, Article 1.20-1.03.01.

NOTICE TO CONTRACTOR – SUBMITTALS

The Contractor is hereby notified that submittals, including shop and working drawings, computations and calculations, catalog cuts, data sheets and all other materials the Contractor submits to CTDOT shall be PREPARED AND SUBMITTED IN DIGITAL FORMAT. All correspondence including drawings submitted for review and/or approval, submittals, etc. will be transmitted by all parties in digital format, in accordance with Form 816 Article 1.20-1.05.02 and the latest CTDOT Policies and Procedures. All submittals shall be produced and controlled using SharePoint, in accordance with Item No. 0969050A – Document Control Specialist.

Transmittal of Submittals: Unless otherwise stipulated, all submittals requiring review for conformance with the Contract shall be digitally transmitted to Wendel ATTN: Karolina Bazylewicz, 140 John James Audubon Parkway, Suite 201, Buffalo, NY, 14228.

A transmittal letter shall be sent to Mr. Theodore H. Nezames, P.E., Transportation Principal Engineer, Facilities Design, Bureau of Engineering and Construction, Connecticut Department of Transportation, 2800 Berlin Turnpike, P.O. Box 317546, Newington, CT 06131-7546, Room 3405, ATTN: Mr. Eric Feldblum.

Copies of the transmittal letter shall be sent to the District 1A Administration Office, 700 State Street140, Suite 101, New Haven, CT 06511, Attention: Lynn Cichowski

Submittals requiring review for conformance with the Contract that shall be printed and submitted directly to the Assistant District Engineer in lieu of the Designer are listed below. Copies of the transmittal letters shall be sent to the Transportation Principal Engineer, Facilities Design.

Concrete Mix Design Certifications
Asphalt Mix Design Certifications
Erosion Control Plan and Materials
Disposal Plan
Welding (Welder) Certificates
Certified Test Reports, Material Certificates, etc. from Form 816 Standard Items (non “A” Items from Bid List)

Submittals requiring review for conformance with the Environmental Contract work shall be printed and hand delivered or sent by mail directly to Mr. Gregory Dorosh, Manager of Environmental Compliance, Bureau of Engineering and Construction, Connecticut Department of Transportation, 2800 Berlin Turnpike, P.O. Box 317546, Newington, CT 06131-7546, Room 3127. Copies of the transmittal letters shall be sent to the Transportation Principal Engineer, Facilities Design and to the Assistant District Engineer.

Health and Safety Plan
Disposal Plan and Site
Lead/Asbestos Abatement Plan

Submittal Preparation and Processing: The Contractor shall provide the Designer with complete submittal packages (Product Data, Shop Drawings, Samples, and Quality Assurance Submittals, as applicable) for individual elements of Project work for a concurrent review of all information. Incomplete submittal packages will be returned to the Contractor without being reviewed.

Unless digitally submitted as specified herein, the Contractor shall submit 9 copies of each required submittal for the Designer's review. The Contractor shall add 1 printed copy of the following CSI Sections for outside agency (FM Global) review:

1. 05 31 00, "Steel Decking"
2. 07 42 13, "Metal Wall Panels"
3. 07 54 23, "Thermoplastic Polyolefin (TPO) Roofing"
4. 07 71 00, "Roof Specialties"
5. 07 81 23, "Intumescent Fireproofing"
6. 07 84 13, "Penetration Firestopping"
7. 07 84 46, "Fire Resistive Joint Systems"
8. 08 11 13, "Hollow Metal Doors and Frames"
9. 08 33 23, "Overhead Coiling Doors"
10. 08 36 13, "Sectional Doors"
11. 08 41 13, "Aluminum Framed Entrances and Storefronts"
12. 08 44 13, "Glazed Aluminum Curtain Walls"
13. 08 62 00, "Unit Skylights"
14. 08 80 00, "Glazing"
15. 11 14 00, " Fuel and Fluid Management"
16. 11 51 00, "Shop Equipment"
17. 11 56 00, "Fueling System Equipment"
18. 21 05 23, "General Duty Valves for Water Based Fire Suppression Piping"
19. 21 12 00, "Fire Suppression Standpipes"
20. 21 13 13, "Wet Pipe Sprinkler Systems"
21. 21 13 16, "Dry Pipe Sprinkler Systems"
22. 22 11 19, "Domestic Water Piping Specialties"
23. 23 05 23, "Valves"
24. 23 05 29, "Supports and Anchors"
25. 23 52 16, "Condensing Boilers".
26. 23 72 00, "Air-To-Air Energy Recovery Units"
27. 26 41 13, "Lightning Protection System".
28. 28 31 00, "Voice Communication Fire Alarm and Detection System".
29. 33 10 00, "Water Distribution System".

Shop Drawings: Unless digitally submitted as specified herein, the Contractor shall submit 1 correctable translucent reproducible print and 8 blue- or black-line prints for the Designer's review. The Contractor shall add 1 printed blue- or black-line print for each of the above noted CSI Sections for outside agency review.

Samples: Where Samples are for selection of color, pattern, texture or similar characteristics from a range of choices, submit two (2) full sets of the standard and custom choices for the material or product. Where Samples illustrate assembly details, workmanship, fabrication techniques, connections, operation and similar characteristics, submit one (1) sample (or set, if applicable).

Designer's Action: The Designer will digitally return submittals marked with action taken and corrections or modifications required.

Shop Drawings: The Designer will return shop drawings digitally. The digital copy shall be considered a "Record Document" and maintained as such.

Samples: The Designer will return one set of samples marked with the action taken. The set of samples shall be maintained at the Project site when returned.

Maintenance manuals and warranties will not be returned unless they are rejected.

NOTICE TO CONTRACTOR – USE OF STATE POLICE OFFICERS

The Department will reimburse services of State Police Officers as a direct payment to the Department of Emergency Services and Public Protection. Payment for State Police Officers utilized by the Contractor for its convenience, not approved by the Engineer, is the responsibility of the Contractor. No separate payment item for State Police Officers is included in this contract.

Any costs associated with coordination and scheduling of State Police Officers will be included under the cost of Item No. 0971001A – Maintenance and Protection of Traffic.

NOTICE TO CONTRACTOR – STANDARD SPECIFICATIONS

Whenever and wherever "ConnDOT Form 816," "Form 816," "Standard Specifications" are referenced herein, this shall mean and refer to "State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 816", including the Supplemental Specifications.

NOTICE TO CONTRACTOR - ENVIRONMENTAL INVESTIGATIONS

Environmental site investigations have been conducted that involved the sampling and laboratory analysis of soil and groundwater collected from various locations and depths within the project limits for the proposed bus storage and maintenance facility and the proposed sanitary pump station on Frost Bridge Road. The results of the environmental investigation indicated the presence of extractable total petroleum hydrocarbons (ETPH), semi-volatile organic compounds (SVOCs), specifically polycylic aromatic hydrocarbons (PAHs), and leachable lead at concentrations exceeding the applicable Connecticut Department of Energy and Environmental Protection (CTDEEP) Remediation Standard Regulations (RSRs) in soil within the project limits. Low concentrations of ETPH, volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs) and PAHs were also detected in the soils at concentrations below the applicable CTDEEP RSR criteria.

In the area of the proposed Bus Maintenance and Storage Facility and the proposed sanitary pump station, the CTDEEP has designated the groundwater as "GA". Total arsenic was detected in groundwater at the site at a concentration exceeding effluent limits for discharge to surface water, however, dissolved arsenic was not detected above analytical detection limits (ND). VOCs and ETPH were detected in the groundwater at the site, but at concentrations below effluent limits for discharge to surface water. Therefore, groundwater at the site is not considered contaminated and dewatering fluids generated during construction activities shall be managed in accordance with the General Permit for the Discharge of Stormwater and Dewatering Wastewaters Associated with Construction Activities for the project. However, if contamination is encountered during dewatering activities controlled management and disposal of contaminated groundwater in accordance with DEEP permits may be required.

Based on these findings, two (2) Areas of Environmental Concern (AOECs) for soil exist within the proposed project limits where contaminants are present at concentrations that exceed the applicable CTDEEP RSR criteria.

In addition, one (1) Low Level Areas of Environmental Concern (LLAEOCs) for soil has been designated, where contaminants were detected at concentrations below the applicable CTDEEP RSR criteria, but above laboratory detection limits. The presence of the compounds at these concentrations <u>will not</u> require material-handling measures beyond those required for normal construction operations. The presence of these compounds at these concentrations <u>will</u> require the disposition of soils excavated from these areas to be restricted as described herein. Material excavated from within the LLAOEC that cannot be reused within the Project limits will require disposal at an approved treatment/disposal facility in accordance with Item No. 0202315A - Disposal of Controlled Materials.

All soil excavated outside of the AOECs and LLAOEC (clean soil) shall be kept separate from soil excavated from the AOECs and LLAOEC. This clean soil shall become the property of the Contractor and be disposed of in accordance with Specifications Section 2.02.

The Contractor is hereby notified that controlled materials requiring special management or disposal procedures will be encountered during various construction activities conducted within the project limits. Therefore, the Contractor will be required to implement appropriate health and safety measures for all construction activities to be performed within the AOECs. These measures shall include, but are not limited to, air monitoring, engineering controls, personal protective equipment and decontamination, equipment decontamination and personnel training. WORKER HEALTH AND SAFETY PROTOCOLS WHICH ADDRESS POTENTIAL AND/OR ACTUAL RISK OF EXPOSURE TO SITE SPECIFIC HAZARDS IS SOLELY THE RESPONSIBILITY OF THE CONTRACTOR.

All suitable material excavated within the AOEC's may be utilized as fill/backfill within its originating AOEC and all suitable material excavated from within the LLAOEC shall be utilized as fill/backfill within the project limits, in accordance with the following conditions: (1) such soil is deemed to be structurally suitable for use as fill by the Engineer; (2) such soil is not placed below the water table; 3) the CTDEEP groundwater classification of the area where the soil is to be reused as fill does not preclude said reuse; and (4) such soil is not placed in an area subject to erosion. Soils within the LLAOEC are to be reused on-site prior to the use of other soils and/or fill such that no excess soils requiring off-site disposal are generated from the LLAEOC.

The Sections which shall be reviewed by the Contractor include, but are not limited to, the following:

- Item No. 0101000A - Environmental Health and Safety
- Item No. 0101117A - Controlled Materials Handling
- Item No. 0101128A - Securing, Construction and Dismantling of a Waste Stockpile and Treatment Area
- Item No. 0202315A - Disposal of Controlled Materials
- Item No. 0202318A – Management of Reusable Controlled Material

The Contractor is alerted to the fact that a Department environmental consultant will be on site for excavation activities within the AOECs, to collect soil samples and groundwater samples (if necessary), and to observe site conditions for the State. **The WSA on the plans is to be used exclusively for temporary stockpiling of excavated materials from within project AOEC's and excess excavated materials from within the project LLAOEC for determination of disposal classification.**

Information pertaining to the results of the environmental investigations discussed can be found in the documents listed below. These documents shall be available for review at the Office of Contracts, 2800 Berlin Turnpike, Newington, Connecticut.

- Task 210: Subsurface Site Investigation Report. Greater Waterbury Area Bus Maintenance and Storage Facility, Watertown, Connecticut. CDR Maguire, Inc., March 21, 2014.

NOTICE TO CONTRACTOR – STANDARD SPECIFICATIONS

Whenever and wherever "ConnDOT Form 816," "Form 816," "Standard Specifications" are referenced herein, this shall mean and refer to "State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 816", including the Supplemental Specifications.

NOTICE TO CONTRACTOR – GENERAL REQUIREMENTS AND COVENANTS OF THE CONTRACT

Division I of the document entitled "State of Connecticut, Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, Form 816, 2004," including the Division I Supplemental Specifications (exclusive of references to Method of Measurement and Basis of Payment) shall collectively be known as the "General Requirements and Covenants of the Contract."

The Contractor is hereby advised of the potential for conflicts between provisions contained within Section 1.20 of the Form 816 with other Division I Sections of the Form 816. Where the aforementioned conflicts occur, Section 1.20 shall govern.

Division I, General Requirements and Covenants and Division III, Materials Section; exclusive of references to Method of Measurement and Basis of Payment

NOTICE TO CONTRACTOR – MEASUREMENT AND PAYMENT

This Project is being bid with both lump sum and unit price items. The bid items include unit price and lump sum items which are IN ADDITION TO the Major Lump Sum Item (MLSI) of the Project, Item No. 0100150A, titled "-Maintenance Facility and Item No. 1408801A, titled "Pump Station Building and Equipment". These separate items will be measured for payment on a unit price or lump sum basis (whichever is applicable) for which a separate bid price is required, at the quantities as indicated in the Bid Proposal Form. Each item to be measured is more specifically described in a corresponding Form 816 Standard Specification related to that item, or a special provision, as applicable.

Standard Form 816 Items are referenced by their standard item numbers. Refer to the applicable article of Form 816 for the requirements for this item. Special Provisions included in this Contract are referenced by their item number followed by an "A" suffix. Refer to the Special Provisions contained within this Contract for requirements for this item.

All work depicted on the Contract Plans and described in the Contract Specifications, including mobilization, is included in the MLSI of the Project, with the exception of the unit price or other lump sum items listed in the Bid Proposal Form. Any work incidental to an item which is not specifically described or included in the item, but which is required for performance and completion of the work required under the Contract, is included in the MLSI.

NOTICE TO CONTRACTOR – NOTICE OF INTENT TO CONSTRUCT

The Contractor is hereby advised that a Notice of Intent to Construct (NOIC) will be issued as the Building Permit for this Project in accordance with CGS. The Contractor will not be required to apply for a Building Permit from the local Building Official.

NOTICE TO CONTRACTOR – FTA BUY AMERICA

The Contractor agrees to comply with 49 U.S.C. 5323(j) and 49 CFR Part 661, which provide that Federal funds may not be obligated unless steel, iron, and manufactured products used on Federal Transit Administration (FTA) –funded projects are produced in the United States, unless a waiver has been granted by FTA or the product is subject to a general waiver. General waivers are listed in 49 CFR 661.7.

The Contractor also agrees to comply with the American Recovery and Reinvestment Act ("Act") Section 1605 of Division A, Title IX, "Buy American" requirements. Where there is a conflict between the requirements of 49 CFR Part 661 "Buy America" and Division A, Title XVI, Section 1605 "Buy American" of the Act, the most restrictive requirement applies.

Bidders must submit the appropriate certificate, as set forth below, of either a completed Certificate of Compliance or a completed Certificate for Non-Compliance with their bid. These certificates are attached to the bid proposal form. Failure to complete and submit one of the referenced certificates will result in rejection of the bid.

Certificate of Compliance with Buy America Requirements

The bidder or offeror hereby certifies that it will comply with the requirements of 49 U.S.C. 5323(j)(1), and the applicable regulations in 49 CFR part 661.

Date _____
Signature _____
Company _____
Name _____
Title _____

Certificate of Non-Compliance with Buy America Requirements

The bidder or offeror hereby certifies that it cannot comply with the requirements of 49 U.S.C. 5323(j), but it may qualify for an exception to the requirement pursuant to 49 U.S.C. 5323(j)(2), as amended, and the applicable regulations in 49 CFR 661.7.

Date _____
Signature _____
Company _____
Name _____
Title _____

The Contractor shall obtain and submit to the State copies of all signed Buy America certifications, including Buy America certifications that may be required of its subcontractors if the dollar thresholds established by the FTA are exceeded. These complete certifications if applicable, shall be mailed to the Connecticut Department of Transportation, to the attention of the Department.

NOTICE TO CONTRACTOR – BUILDING AND FIRE CODES

The Contractor is hereby advised of the requirement to purchase one set of all building and fire codes listed in Form 816 Article 1.20-1.02.13 for the Engineer's use. Upon receipt of a Notice to Proceed on the Project, these codes shall be provided to the Engineer. If any codes are not readily available, the Contractor shall provide the Engineer with a copy of the code order form along with an anticipated delivery date. At the end of the Project, the codes will remain the property of the Engineer. The Contractor shall bid the Project accordingly.

NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS

The Contractor is hereby advised that it is the expressed intent of the Department that no materials containing asbestos of any kind or amount be installed in Department facilities as a result of any work being performed under this Contract.

For all materials that have a probability of containing asbestos, the Contractor shall provide a certification letter on the manufacturer's letterhead along with the regular submittal package to prove that asbestos is not contained in the materials. These materials will not be approved without the required manufacturer certification letter. The manufacturer certification letter shall be formatted in the following manner:

[Addressed to:] Commissioner of Transportation
Department of Transportation
P.O. Box 317546
Newington, Connecticut 06131-7546

Project Title and Number

[We] hereby certify that all materials manufactured by [Insert Manufacturer Name] are asbestos-free.

[Signature:] [Name of authorized signatory]
[Title]

The Contractor shall submit manufacturer certification letters for all materials specified in the following Contract provisions (including CSI-formatted specifications contained within a particular special provision):

1. Division 7 Section 071416, "Cold Fluid Waterproofing."
2. Division 7 Section 071616, "Crystalline Waterproofing."
3. Division 7 Section 072100, "Thermal Insulation."
4. Division 7 Section 074213, "Metal Wall Panels."
5. Division 7 Section 075423, "Thermoplastic Polyolefin (TPO) Roofing."
6. Division 7 Section 076200, "Sheet Metal Flashing and Trim."
7. Division 7 Section 077200, "Roof Accessories."
8. Division 7 Section 078123 "Intumescent Fireproofing".
9. Division 7 Section 078413, "Penetration Firestopping."
10. Division 7 Section 079200, "Joint Sealants."
11. Division 8 Section 087100, "Door Hardware."
12. Glazing Tapes and Sealants: Division 8 Section 088000, "Glazing."
13. Division 9 Section 092116.23, "Gypsum Board Shaft Wall Assemblies."

14. Division 9 Section 092900, “Gypsum Board.”
15. Division 9 Section 093000, “Tiling.”
16. Division 9 Section 095113, “Acoustical Panel Ceilings.”
17. Division 9 Section 096513, “Resilient Base and Accessories.”
18. Division 9 Section 096813, “Tile Carpeting.”
19. Division 21 Section 210548.13, “Vibration Controls for Fire Suppression Systems.”
20. Division 21 Section 211313, “Wet-Pipe Sprinkler Systems.”
21. Division 21 Section 211316, “Dry-Pipe Sprinkler Systems.”
22. Division 22 Section 220548, “Vibration and Seismic Controls for Plumbing Piping and Equipment.”
23. Division 22 Section 220719, “Plumbing Piping Insulation.”
24. Division 22 Section 223300, “Electric, Domestic Water Heaters.”
25. Division 23 Section 237430, “Gas Fired Makeup Air Units.”

The above list may not be all-inclusive and does not relieve the Contractor from its responsibility to provide manufacturer certification letters that are required under other Contract provisions. Furthermore, the Department may at any time require the Contractor to submit manufacturer certification letters proving that other materials do not contain asbestos.

Failure of the Contractor to provide the required documentation will result in the immediate removal of the material from the Project by the Contractor at its expense. The Contractor shall be responsible for all costs incurred as a result of such required action, and replacements thereof, in order to complete the Project.

Any asbestos containing material that is found to have been installed as a result of work performed under this Contract will be required to be removed by the Contractor at its expense as soon as such determination is made. The Contractor shall also replace the removed material with appropriate material that is in compliance with the Contract. The Contractor is also responsible to pay for any asbestos testing charges the Department incurred in order to prove that the material contains asbestos fibers. This obligation will extend throughout the one-year warranty period after the issuance of the Certificate of Compliance.

The Contractor shall complete and sign the attached certification form assuring the Department that no asbestos-containing materials have been used in the construction of this Project. This form shall be submitted prior to the Semi-Final Inspection. The Certificate of Compliance will not be issued without this completed and signed certification form.

CONTRACTOR CERTIFICATION:

RE/ ASBESTOS CONTENT OF MATERIALS

State of Connecticut
Department of Transportation
PO Box 317546
Newington, CT 06131-7546

1. Project Number: _____

2. Project Name: _____

3. Contractor Name: _____

4. This is to certify that I have read, understood, and complied with the terms and conditions identified under the "NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS" included in this Contract.

   I fully understand that it is the requirement of the Connecticut Department of Transportation that only materials that do not contain asbestos of any kind or amount are to be utilized in the construction of this Project.

   I therefore certify that, to the best of my knowledge, all materials installed under this Contract are asbestos-free.

   For the one-year warranty period after the issuance of the Certificate of Compliance, I agree to remove any asbestos-containing material identified by the Connecticut Department of Transportation and reinstall an approved, non-asbestos-containing material that is in compliance with the original Contract at no additional cost to the State.

5. Date of Certificate of Compliance: _____

6. Date of the Asbestos Certification: _____

7. Signature of Authorized Party Agreeing to the Terms & Conditions Identified Herein & as Further Stated in the Contract:

_____	_____
Signature	Title
_____	_____
Printed Name	Date

NOTICE TO CONTRACTOR – OFF-SITE STAGING AND STORAGE

The Contractor is hereby advised that due to the restrictive Project Limits and other operational constraints identified in the Contract, off-site staging and storage of materials and equipment may be required. Arrangement for off-site staging and storage of materials and equipment shall be the responsibility of the Contractor. Payment for off-site staging and storage of materials and equipment shall be in accordance with Form 816 Article 1.09.06. The Contractor shall bid the Project accordingly.

NOTICE TO CONTRACTOR – COLD WEATHER CONCRETE ACTIVITIES

The Contractor is hereby advised of the potential need for cold weather concrete activities. The Contractor shall strictly adhere to all required cold weather concrete procedures as specified within the Contract and conduct its activities accordingly. The Contractor shall bid the Project accordingly.

NOTICE TO CONTRACTOR – PROJECT DESCRIPTION

The Project consists of the construction of a Bus Maintenance Facility located on Frost Bridge Road in Watertown, Connecticut. The building is a multiple story facility. The Ground Floor contains an open structure employee car parking area. The First Floor consists of bus storage, vehicle wash, (12) vehicle maintenance bays, (1) tire/ brake shop, (1) building and grounds repair shop, (1) parts storage room, (1) chasis wash room, (1) lube room, (1) unit shop and an operations office area. The Second Floor contains administration space. The building is steel frame construction with exterior facades consisting of ground faced block, glazed aluminum curtainwalls and metal wall panels. The facility also includes a guard booth.

The work includes concrete, masonry, structural steel, steel joists, steel floor and roof deck, waterproofing, insulated single-ply membrane roofing, roofing specialties, roofing accessories, sheet metal, steel doors and frames, overhead coiling doors, overhead sectional doors, aluminum framed entrances and storefronts, aluminum curtainwalls, door hardware, glazing, interior finishes and furnishings including horizontal louver blinds signage, entrance mats and millwork, interior gypsum partitions, plumbing, prefabricated paint spray booth structure, elevators, cranes, vehicle lifts, heating-ventilating-air conditioning, electrical systems, lighting, communications systems, and electronic safety and security systems.

Site work associated with this facility consists of excavation and grading work to accommodate the building; removal and disposal of existing pavement, trees, debris; removal of storm sewer pipe and drainage structures; installation of a waterline, on-site pump station, off-site pump station, sanitary sewer and forcemain; installation of new pavement; installation of retaining walls; installation of oil-water separators; and fencing.

NOTICE TO CONTRACTOR – LIMITATION OF CONTRACTOR OPERATIONS

The Contractor is prohibited from storing equipment, materials and perform staging operations within the 100 year floodplain or floodway without review and written approval.

NOTICE TO CONTRACTOR – ENGINEER OCCUPANCY

The Engineer and the Department personnel will occupy the Project Site during the entire construction period.

The Engineer reserves the right to occupy and to place and install equipment in completed areas of the Facility, prior to Final Inspection and the issuance of the Certificate of Compliance provided that such occupancy does not interfere with completion of the Project. Such placing of equipment and partial occupancy shall not constitute acceptance of the total Project. The Contractor shall allow and cooperate with such occupancy at no additional cost to the State.

1. The Engineer shall obtain from the Contractor written approval of such occupancy. The Engineer shall determine whether such occupancy or use is possible and, if so, will make arrangements for holding a job inspection with representatives of the Department and the Contractor.
2. Based on the inspection, a "Punch List" of outstanding or unacceptable work shall be developed.
3. The Contractor shall prepare a letter to the Engineer granting occupancy. The letter granting such occupancy shall state the terms and conditions of occupancy and include the status of completion of "Punch List" items.
4. Subsequent to the receipt of the letter granting occupancy, the Engineer shall notify the Contractor in writing that fire insurance coverage has been requested, and the effective date the Contractor may cancel the fire insurance coverage normally carried on the building by it.
5. Prior to partial Engineer occupancy, mechanical and electrical systems shall be fully operational. Required inspections and tests shall have been successfully completed. Upon occupancy the Engineer will provide operation and maintenance of mechanical and electrical systems in occupied portions of the building.

NOTICE TO CONTRACTOR – PROJECT PHASING REQUIREMENTS

Although the Contractor is responsible for developing its own phasing plan for the Engineer's approval for the Project work, the following outline-phasing plan requires certain Project work to be performed during specific time periods:

Phase 1
The Contractor shall:

A. *Begin and complete installation of fencing and gate required to secure the entire Project site.*
B. *Begin and complete Environmental and Safety controls.*
C. *Begin and complete installation of construction trailers where indicated on the drawings. Provide temporary power and communications as required by the contract.*
D. *Begin and complete installation of personnel Restroom trailers including temporary water and sewer as indicated on drawings.*

Phase 2
The Contractor shall:

A. *Begin and complete clearing and grubbing, site layout and rough grading and excavation.*
B. *Begin and complete off-site utilities.*
C. *Begin and complete off-site pump station no.2.*
D. *Begin and complete on-site utilities/ storm drainage.*

Phase 3
The Contractor shall:

A. *Begin and complete foundations and underslab utilities.*
B. *Begin and complete concrete slabs on grade.*
C. *Begin and complete structural steel erection and composite flood construction.*
D. *Begin and complete exterior envelope.*

Phase 4
The Contractor shall:

A. *Begin and complete interior partitions.*
B. *Begin and complete mechanical, electrical and plumbing rough-ins.*
C. *Begin and complete setting mechanical equipment.*
D. *Begin and complete bus equipment and lifts.*
E. *Begin and complete mechanical, electrical and plumbing fixtures.*
F. *Begin and complete interior finishes and signage.*

<u>Phase 5</u>
The Contractor shall:

A. *Begin and complete start-up/ commissioning..*
B. *Begin and complete punch-list.*
C. *Substantially completion.*

<u>Phase 6</u>
The Contractor shall:

A. *Begin and complete close-out procedures.*
B. *Final completion.*

The Engineer will hold a Semi-Final Inspection for the Project. Once the Department personnel have permanently reoccupied the building, the Contractor shall remove the temporary facilities as described in Form 816 Article 1.20-1.08.03 and complete any remaining site construction.

NOTICE TO CONTRACTOR – UTILITY SERVICE CONNECTIONS AND RELOCATIONS

The electric, telephone, gas, water (including fire protection), and sewer services to the Project Site require service connections to the applicable utility company's facilities. Utility service connection relocations and installations to the point of the utility service are included as shown and described within the Contract.

The Contractor is responsible for notifying the utility company prior to the need for the utility connection, and for coordinating the service connection and/or relocation requirements with the utility company. The Contractor shall coordinate with the following utility companies:

Electric:	Connecticut Light and Power – CL&P
Telephone:	AT&T
Gas:	Yankeee Gas
Water:	Town of Watertown
Sewer:	Town of Watertown

Where known, utility company representatives are identified elsewhere within the Contract.

Electric

An allowance is included in the Contract to reimburse Connecticut Light and Power – CL&P for the utility's fees and work related to the Project. All Contractors will include the amount of $21,252.00 for utility service charges in the Contract Bid Price. If it is determined that different charges apply, the Contractor's bid will be adjusted to reflect the differential by construction order, provided that the Contractor provides all applicable written billing documentation. The Contractor will be compensated only for the difference between the billed amount and the estimated amount. No additional Contractor markup will be allowed. The Contractor is responsible for coordinating this work with the utility company and for administrative requirements for reimbursing the utility company.

CL&P will provide and completely install primary electrical cable in conduit provided by contract documents. CL&P will provide and install utility transformer and terminate primary and secondary conductors, transformer pad shall be by contractor. Utility pole at street shall be by utility with riser stub-ups provided by contractor.

Telephone

AT&T will provide and terminate communications cabling to the facility in conduit provided by contractor. AT&T will not charge for this service.

Gas

An allowance is included in the Contract to reimburse Yankee Gas for the utility's fees and work related to the Project. All Contractors will include the amount of $200,000 for utility service charges in the Contract Bid Price. If it is determined that different charges apply, the

Contractor's bid will be adjusted to reflect the differential by construction order, provided that the Contractor provides all applicable written billing documentation. The Contractor will be compensated only for the difference between the billed amount and the estimated amount. No additional Contractor markup will be allowed. The Contractor is responsible for coordinating this work with the utility company and for administrative requirements for reimbursing the utility company.

Yankee Gas will provide and completely install a new gas main extension to service the site. The gas main will connect to an existing gas main on Waterbury Road (S.R. 848) and will extend along Frost Bridge Road to the entrance to the site.

The gas service line will run from the new gas main at Frost Bridge Road to the point of connection to the building. Contractor will be responsible for trenching and bedding per detail provided on the plans. Yankee Gas will provide the gas service pipe, place it in the trench, and make connections at the main and at the building. The Contractor will then backfill the trench. The Contractor will be responsible for proper disposal of spoils from the installation.

Timing of the work must be closely coordinated with the utility and with the Resident Engineer. Yankee Gas must be notified a minimum of 8-weeks prior to anticipated commencement of the work. Installation must be completed prior to installation of sidewalks, curbing, and pavement but cannot commence until site grading (fill) along the proposed gas service alignment is at or near final grade.

<u>Water</u>
An allowance is not required, as the final connection will made under a different contract.

<u>Sewer</u>
An allowance is not required, as the final connection will made under a different contract.

NOTICE TO CONTRACTOR – EARLY SUBMITTALS

The Contractor is hereby advised that the Department has identified the potential need to order certain materials and equipment, and thereby submit certain submittals for approval early in the construction process to ensure the Project is completed within the allowable Contract Time. Submittals shall be in accordance with Form 816 Article 1.20-1.05.02. The following items have been identified as possibly requiring early ordering thereby requiring early submission of shop drawings and product data, including color selection charts and samples:

1. Division 5 Section 051200 "Structural Steel Framing"; structural steel.
2. Division 5 Section 051200 "Structural Steel Framing"; steel joists.
3. Division 8 Section 087100 "Door Hardware"; door hardware.
4. Division 21 Section 211313 "Wet Pipe Sprinkler Systems"; sprinkler system.
5. Division 21 Section 211316 "Dry Pipe Sprinkler Systems"; sprinkler system.
6. Division 23 Section 237200 "Air to Air Energy Recovery Units"; air recovery units.
7. Division 33 Section 333213.13A.4 "Above Grade Wet Well Mounted Quad-Plex Pump Station - Pump Station No.2, pump station.
8. Division 33 Section 333213.13B.2 "Recessed Wet Well Mounted Duplex Pump Station - Pump Station No.1, pump station.

The following items have been identified as possibly requiring early submission for purposes of project coordination and project work scheduling:

Selection of the Project Coordinator
Baseline Critical Path Schedule
Contractor's Submittal Schedule

The lists above are not intended to be all-inclusive and do not relieve the Contractor from coordinating the activities of its subcontractors and suppliers. The Contractor will not be permitted to perform any physical work on the Project without the approval of the required submittals. Failure to properly plan for long lead items within the Contract schedule will not be justification for additional construction time.

It is recommended that the Contractor identify early in the construction sequencing process the subcontractors and suppliers associated with long lead-time items and submit the appropriate shop drawings and supporting data, including color selection charts and samples, for review upon Notice to Proceed.

NOTICE TO CONTRACTOR – SOLE SOURCE PRODUCTS

For operational purposes, the Department has determined the need to sole source products specified in the following Contract provisions (including specific CSI-formatted Specifications contained within a particular Special Provision):

1. Fuel and Fluid Management System: Division 11; Section 11 14 00 "Fuel and Fluid Management System".

2. SCADA System: Division 11; Section 33 32 13.13A.4 "Above Grade Wet Well Mounted Quad-Plex Pump Station – Pump station No.2".

3. Water Meters: Division 33; Section 33 10 00 "Water Distribution System".

4. Door Cylinders: Division 08; section 087 71 00; "Door Hardware".

No "Or Equals" will be permitted. Said products shall be installed only by their factory authorized installer or service representative. The Contractor shall bid the Project accordingly.

NOTICE TO CONTRACTOR – PRE-INSTALLATION MEETINGS

The Engineer will conduct a pre-installation meeting at the Project Site before each of the following construction activities:

1. Concrete: CSI Division 03 Section 033000, "Cast-In-Place Concrete."
2. Post Tensioned Concrete: CSI Division 03 Section 033610, "Bonded Post-Tensioned Concrete".
3. Unit Masonry: CSI Division 04 Section 042000 "Unit Masonry".
4. Steel: CSI Division 05 Section 051200 "Structural Steel Framing".
5. Metal Framing: CSI Division 05 Section 054000 "Cold Formed Metal Framing".
6. Cabinets and Countertops: CSI Division 06 Section 064032 "Interior Architectural Woodwork".
7. Waterproofing: CSI Division 07 Section 071416, "Cold Fluid Applied Waterproofing."
8. Waterproofing: CSI Division 07 Section 071616 "Crystalling Waterproofing".
9. Air Barrier: CSI Division 07 Section 072713 "Modified Bituminous Sheet Air Barriers".
10. Metal Wall Panels: CSI Division 07 Section 074213 "Metal Wall Panels".
11. Roofing: CSI Division 07 Section 075423 "Thermoplastic Polyolefin (TPO) Roofing".
12. Sheet Metal: CSI Division 07 Section 076200 "Sheet Metal Flashing and Trim".
13. Roof Specialties: CSI Division 07 Section 077100 "Roof Specialties".
14. Intumescent Fireproofing: CSI Division 07 Section 078123 "Intumescent Fireproofing"
15. Firestopping: CSI Division 07 Section 078413 "Penetration Firestopping".
16. Fire Resistive Joints: CSI Division 07 Section 078446 "Fire-Resistive Joint Systems".
17. Joint Sealants: CSI Division 07 Section 079200 "Joint Sealants".
18. Doors and Frames: CSI Division 08 Section 081113 "Hollow Metal Doors and Frames".
19. Doors and Frames: CSI Division 08 Section 081119 "Stainless-Steel Doors and Frames".
20. Frames: CSI Division 08 Section 081216 "Aluminum Frames".
21. Wood Doors: CSI Division 08 Section 081416 "Flush Wood Doors".
22. Entrances and Storefronts: CSI Division 08 Section 084113 "Aluminum-Framed Entrances and Storefronts".
23. Doors and Frames: CSI Division 08 Section 083463 "Detention Doors and Frames".
24. Curtainwalls: CSI Division 08 "084413 Glazed Aluminum Curtain Walls".
25. Security Windows: CSI Division 08 085653 "Security Windows".
26. Key and Pre-submittal Conference: CSI Division 08 Section 087100 " Door Hardware".
27. Glazing: CSI Division 08 Section 088000 "Glazing".
28. Review Substrates: CSI Division 09 Section 093000 "Tiling".
29. Ceiling: CSI Division 09 Section 095133 "Acoustic Panel Ceilings".
30. Review Substrates: CSI Division 09 Section 096536 "Static-Control Resilient Flooring".
31. Methods and Procedures: CSI Division 09 Section 096623 "Resinous Matrix Terrazzo Flooring".
32. Carpet: CSI Division 09 Section "096813 "Tile Carpeting".
33. Coordination: CSI Division 09 Section 096900 "Access Flooring".
34. Coordination: CSI Division 10 Section 105113 "Metal Lockers".
35. Coordination: CSI Division 13 Section 131200 "Canopies".

36. Testing, Adjusting, and Balancing: CSI Division 23 Section 230593, “Testing, Adjusting, and Balancing .”
37. Building Automation System: CSI Division 23 Section 230900, “Instrumentation and Control for HVAC.”
38. Concrete Fill: CSI Division 31 Section 313000, “Low Density Foam Concrete Fill”.
39. Pavers: CSI Division 32 Section 321400, “Unit Paving.”

The above list may not be all-inclusive and does not relieve the Contractor from its responsibility to provide pre-installation meetings that are required under other Contract provisions.

NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS

General: The list of CSI-formatted specifications in the Table below may not be all-inclusive and does not relieve the Contractor from its responsibility to provide spare parts, operation and maintenance manuals, training, and warranties that are required under other Contract provisions.

This Table will be forwarded to Mr. Phillip T. Scarrozzo, Manager, Bureau of Public Transportation, for concurrence prior to the Semi-Final Inspection.

Spare Parts: The Contractor shall deliver spare parts on products listed in the Table below to the Project Site.

Operation and Maintenance Maunals: Submit 4 copies of each manual to the Designer. The Designer and Mr. Phillip T. Scarrozzo, Manager, Bureau of Public Transportation, will review the manuals for conformance to the Contract. The manuals will be processed in accordance with Form 816 Article 1.20-1.05.02, with 3 copies being forwarded to Mr. Phillip T. Scarrozzo,and one copy being sent to the Engineer.

Materials and Finishes Maintenance Manual: The Contractor shall provide complete information in the materials and finishes manual on products listed in the Table below.

Equipment and Systems Maintenance Manuals: The Contractor shall provide complete information in the equipment and systems manual on products listed in the Table below.

Training: The Contractor shall provide training on products listed in the Table below. All training sessions shall be videotaped by the Contractor, with three (3) DVD copies forwarded to Mr. Phillip T. Scarrozzo, Manager, Bureau of Public Transportation, and one copy provided to the Engineer. The DVDs provided by the Contractor shall not be copy-protected in order to allow future copying and distribution by the Department as needed.

All training sessions required by the Contract Documents shall be coordinated and scheduled through the Commissioning Authority. Reference NOTICE TO CONTRACTOR - COMMISSIONING for a sample Training Form and Evaluation Form.

Training Instructors shall be a Manufacturer's Representative or Applications Engineer fully qualified in the operation, troubleshooting and maintenance procedures for the equipment or systems being covered. Sales Representatives or others possessing only general knowledge of the equipment or systems will not be acceptable.

The following format shall be used to schedule, perform, document and evaluate the required training sessions:

1. The Contractor shall submit a separate Training Form for each training session required by the Contract Documents to the Commissioning Authority. This form shall be submitted a minimum of fourteen (14) calendar days in advance of the proposed training session.
2. The Contractor shall complete the first section of the form including the proposed training session date, name of instructor(s), and proposed length (time) of the session(s). Also, attach an Agenda indicating the format of the training session and listing any handouts that will be provided.
3. The Commissioning Authority will then review the proposed training information with the Owner. If the submitted information is complete and the proposed dates meet the Owner's Operations Personnel schedule, the Commissioning Authority will respond to the Contractor to proceed with scheduling the subject training session.
4. During the training session, the Contractor shall have all in attendance sign in the third section of the Training Form. Attach additional pages if necessary. The Contractor shall then forward the Training Form to the Commissioning Authority.
5. After each Training Session is completed, the Cx Authority will issue an Evaluation Form to each of the Attendees. This feedback information will be provided to the Owner and Designer for review. If the session meets the objectives and intent of the Contract Documents, the Commissioning Authority will approve the training form and return to the Contractor for Project Records. If negative feedback is received, the Evaluation Forms will be reviewed with the Commissioning Team and if necessary, re-scheduling of the training may be required.

Training sessions shall cover the following items:

1. Review of Operations and Maintenance Manuals
2. Review of As-built Drawings
3. Overview of system components
4. System operation under normal conditions
5. System operation under abnormal conditions
6. Emergency procedures
7. Troubleshooting procedures
8. Maintenance and Repair procedures
9. Questions

The Contractor is responsible for all costs associated with travel to and from the Training Facility, lodging during the training session and tuition & materials.

Warranties: Submit 4 copies of written warranties, including special warranties to the Designer. The Designer and Mr. Phillip T. Scarrozzo, Manager, Bureau of Public Transportation, will review the warranties for conformance to the Contract. The warranties will be processed in accordance with Form 816 Article 1.20-1.05.02, with 3 copies being forwarded to Mr. Phillip T. Scarrozzo and one copy being sent to the Engineer.

The Contractor shall provide special warranties on products and installations listed in the Table below.

TABLE

CSI-formatted Specifications	Warranties	Spare Parts	Training	Operation and Maintenance Manuals
CSI Section 071416, "Cold Fluid-Applied Waterproofing "	X			
CSI Section 074213, "Metal Wall Panels"	X			X
CSI Section 075423, "Thermoplastic Polyolefin (TPO) Roofing"	X			X
CSI Section 076200, "Sheet Metal Flashing and Trim"	X			
CSI Section 077100, "Roof Specialties"	X			X
CSI Section 077200, "Roof Accessories"	X			X
CSI Section 079200, "Joint Sealants"	X			
CSI Section 081216, "Aluminum Frames"				X
CSI Section 081416, "Flush Wood Doors"	X			
CSI Section 083313, "Coiling Counter Doors"				X
CSI Section 083323, "Overhead Coiling Doors"				X
CSI Section 083613, "Sectional Doors"	X			X
CSI Section 084113, "Aluminum-Framed Entrances and Storefronts"	X			X
CSI Section 084413, "Glazed Aluminum Curtainwalls"	X			X
CSI Section 085653, "Security Windows"	X			
CSI Section 086200, "Unit Skylights"	X			X
CSI Section 087100, "Door Hardware"	X		X	X
CSI Section 087650, "Assistive Window Actuator"	X		X	X
CSI Section 088000, "Glazing"	X			
CSI Section 088300, "Mirrors"	X			X
CSI Section 088853, "Security Glazing"	X			
CSI Section 093000, "Tiling"		X		
CSI Section 095113, "Acoustical Panel Ceilings"		X		

CSI-formatted Specifications	Warranties	Spare Parts	Training	Operation and Maintenance Manuals
CSI Section 096513, “Resilient Base and Accessories”		X		
CSI Section 096519, “Resilient Tile Flooring”		X		X
CSI Section 096536, “Static Control Resilient Flooring”		X		X
CSI Section 096566, “Resilient Athletic Flooring”		X		X
CSI Section 096613, “Portland Cement Terrazzo Flooring”				X
CSI Section 096623, “Resinous Matrix Terrazzo Flooring”				X
CSI Section 096813, “Tile Carpeting”	X	X		X
CSI Section 096900, “Access Flooring”		X		
CSI Section 099123, “Interior Painting”		X		
CSI Section 099600, “High Performance Coatings”		X		
CSI Section 101100, “Visual Display Units”	X			X
CSI Section 101400, “Signage”	X			X
CSI Section 102113, “Toilet Compartments”				X
CSI Section 102800, “Toilet, Bath, and Laundry Accessories”	X			X
CSI Section 103000, “Doorway Spill Barrier”	X	X	X	X
CSI Section 104413, “Fire Protection Cabinets”				X
CSI Section 104416, “Fire Extinquishers”	X			X
CSI Section 105113, “Metal Lockers”	X			X
CSI Section 106700, “Storage Equipment”	X	X	X	X
CSI Section 109900, “Tactile Warning Surface”	X			
CSI Section 111400, “Fuel and Fluid Management System”	X		X	X
CSI Section 115100, “Shop Equipment”	X	X	X	X
CSI Section 115110, “Carbon Monoxide Exhaust Systems”	X	X	X	X
CSI Section 115213, “Projection Screens”				X
CSI Section 115400, “Fare Collection Equipment”	X		X	X
CSI Section 115500, “Vehicle Wash Equipment”	X	X	X	X
CSI Section 115600, “Fueling System Equipment”	X	X	X	X
CSI Section 115700, “Compressed Air Equipment”	X	X	X	X
CSI Section 115710, “Breathing Air System”	X	X	X	X
CSI Section 115800, “Fluid Lubrication Systems”	X	X	X	X
CSI Section 122113, “Horizontal Louver Blinds”		X		X
CSI Section 122413, “Roller Window Shades”		X		X

CSI-formatted Specifications	Warranties	Spare Parts	Training	Operation and Maintenance Manuals
CSI Section 124813, “Entrance Floor Mats and Frames”		X		X
CSI Section 131200, “Canopies”	X			X
CSI Section 142100, “Machine-Room-Less Electric Traction Elevators”	X		X	X
CSI Section 143000, “Cranes”	X	X	X	X
CSI Section 144500, “Vehicle Lifts”	X	X	X	X
CSI Section 211313, “Wet Pipe Sprinkler Systems”		X	X	X
CSI Section 211316, “Dry Pipe Srinkler Systems”			X	X
CSI Section 220553, “Identification for Plumbing Piping and Equipment”				X
CSI Section 221119, “Domestic Water Piping Specialties”				X
CSI Section 221325, “Oil-Water Separator”	X		X	X
CSI section 221345, “Facility Packaged Storm Water Pumping Stations”			X	X
CSI Section 223300, “Electric, Domestic Water Heaters”	X		X	X
CSI Section 224213.13, “Commercial Water Closets”		X		X
CSI Section 224213.16, “Commercial Urinals”		X		X
CSI Section 224216.13, “Commercial Lavatories”		X		X
CSI Section 224216.16, “Commercial Sinks”		X		X
CSI Section 224500, “Emergency Plumbing Fixtures”				X
CSI Section 224716, “Pressure Water Coolers”		X		X
CSI Section 230516, “Pipe Expansion Joints ”	X			X
CSI Section 230519, “Meters and Gauges ”	X			X
CSI Section 230593, “Testing, Adjusting, and Balancing ”	X			
CSI Section 230900, “Instrumentation and Control for HVAC”	X	X	X	X
CSI Section 232113, “Hydronic Piping”				X
CSI Section 232119, “Glycol Injection System”	X			X
CSI Section 232123, “HVAC Pumps”	X			X
CSI Section 233300, “Duct Accessories”		X		
CSI Section 233400, “Fans”	X	X		X
CSI Section 233600, “Air Terminals”		X	X	X
CSI Section 235101, “Positive Pressure Venting System”	X			X
CSI Section 235216, “Condensing Boilers”	X		X	X

CSI-formatted Specifications	Warranties	Spare Parts	Training	Operation and Maintenance Manuals
CSI Section 237200, “Air-To-Air Energy Recovery Units”	X	X	X	X
CSI Section 238126, “Ductless Split System Air Conditioners”	X		X	X
CSI Section 238200, “Terminal Units”	X			X
CSI Section 238316, “Hydronic Radiant Floor Heating Systems”	X		X	X
CSI Section 260519, “Building Wire and Cable”				X
CSI Section 260526, “Grounding and Bonding for Electrical Systems”				X
CSI Section 260529, “Hangers and Supports for Electrical Systems”				X
CSI Section 260533, “Raceways and Boxes for Electrical Systems”				X
CSI Section 260536, “Cable Trays for Electrical Systems”				X
CSI Section 260553, “Electrical Identification”				X
CSI Section 260573.13, “Overcurrent Protective Device Coordination Study”			X	X
CSI Section 260573.16, “Overcurrent Protective Device Short-Circuit Study”			X	X
CSI Section 260573.19-1, “Overcurrent Protective Device Arc-Flash Study”			X	X
CSI Section 260923, “Lighting Control Equipment”			X	X
CSI Section 262100, “Electrical Service – Utility”				X
CSI Section 262200, “Dry Type Transformers”				X
CSI Section 262300, “Switchgear”		X	X	X
CSI Section 262416, “Panelboards and Circuit Breakers”				X
CSI Section 262713, “Electricity Metering”				X
CSI Section 262726, “Wiring Devices”				X
CSI Section 262813, “Fuses”		X		X
CSI Section 262816, “Safety Switches”				X
CSI Section 262900, “Motor Controllers”		X	X	X
CSI Section 263213, “Engine Generator Systems”	X	X	X	X
CSI Section 263600, “Transfer Switches”			X	X
CSI Section 264113, “Lightning Protection Systems”				X
CSI Section 265100, “Interior Lighting Fixtures”	X	X		X
CSI Section 265110, “Lamps and Ballasts”		X		X
CSI Section 265600, “Exterior Lighting”	X	X		X

CSI-formatted Specifications	Warranties	Spare Parts	Training	Operation and Maintenance Manuals
CSI Section 271500, “Communications Horizontal cabling”		X	X	X
CSI Section 273000, “Telephone Systems”			X	X
CSI Section 275116, “Public Address and Mass Notification Systems”			X	X
CSI Section 281300, “Access Control”		X	X	X
CSI Section 282304, “Indoor and Outdoor Surveillance CCTV System”		X	X	X
CSI Section 283100, “Addressable Fire Alarm Detection System”	X	X	X	X
CSI Section 283300, “Wireless Clock System”			X	X
CSI Section 333213.13 A.4 “Above Ground Wet Well Mounted Quad -Plex Pump Station , Pump Station 2		X		X
CSI Section 333213.13 B.2 “Recessed Wet Well Mounted Duplex Pump Station , Pump Station 1		X		X

NOTICE TO CONTRACTOR – SUPPLYING FUEL FOR STORAGE TANKS

Generator Base Tank

The Contractor shall fill all fuel tanks associated with the project as defined in Section 22a-174-42 of the Regulations of Connecticut State Agencies. A sample from the tanker shall be tested to confirm the product's conformance to the State's requirements. The sample shall be taken in the presence of the Engineer. After the performance of all testing, the Contractor shall refill all fuel tanks with the previously described fuel immediately prior to the inspection for the issuance of the C.O.C. An allowance is identified; the Contractor shall include this allowance in its Contract bid. Refer to applicable CSI Sections for additional information in this regard. The fuel shall remain in the storage tanks and shall become the property of the Engineer upon the acceptance of the Project. The Contractor is responsible for the fuel, including any leaks and spills until the Engineer accepts the Project.

The Contractor shall bid the Project accordingly.

NOTICE TO CONTRACTOR – PAINTED SAFETY MARKINGS

The plans depict painted yellow safety markings to be applied to the floors in the Employee Car Parking, Circulation Areas, Bus Storage Areas, Repair Bays, and in the Maintenance Bays. Due to the subjective nature of these markings, the Contractor shall bid the project to assume that the linear footage of safety markings equals 25% more than what is shown on the plans.

The Contractor will provide the Engineer with a minimum of 7 calendar days' notice of the need to install safety markings. The Engineer will coordinate the location of all safety markings with the ConnDOT Safety Division.

The Contractor shall bid the Project accordingly.

NOTICE TO CONTRACTOR – THRESHOLD BUILDING

The Contractor is hereby notified that the construction of this project exceeds the threshold limits defined in CGS Section 29-276(b), and is therefore considered a threshold building. As such, this project will be subject to "Special Inspections" in addition to the inspections outlined in Form 816 Article 1.20-1.05.10.

NOTICE TO CONTRACTOR – THRESHOLD BUILDING PERMIT REQUIREMENTS

A building permit must be obtained from the State Building Inspector to construct the primary structural elements of the Bus Maintenance Facility. (This includes all Contractor or subcontractor designed precast elements. The elements to be designed are outlined in NOTICE TO CONTRACTOR – THRESHOLD BUILDING DESIGN AND CALCULATION SUBMISSION REQUIREMENTS.)

In order to obtain the building permit, the Designer and Peer Reviewer must review and approve all primary structural elements and submit the approved design to the State Building Inspector for review. In accordance with CGS 29-252a(b), the State Building Inspector has 30 calendar days to review the approved design and issue the building permit. The Contractor shall account for this review time in its construction schedule.

NOTICE TO CONTRACTOR – THRESHOLD BUILDING & SPECIAL INSPECTIONS

The Contractor is hereby notified that the construction of this project exceeds the threshold limits defined in CGS Section 29-276(b), and is therefore considered a threshold building.

This Project will also be subject to "Special Inspections" in addition to the inspections outlined in Form 816 Article 1.20-1.05.10. These inspections will be performed by the Engineer's representative and are required by building code officials. As such, the Contractor must follow the requirements outlined in Form 816 Article 1.20-1.05.10.

The following Schedule of Special Inspections is the minimum that shall be coordinated with the Engineer.

Schedule of Inspection and Testing Agencies

Special Inspection Agencies	**Firm**	
1. Special Inspection Coordinator	*Connecticut Department of Transportation – District 1A Construction*	
2. Special Inspector	*Wendel*	
3. Third Party Reviewer	*Jacobs Engineering Group*	
4. Testing Agency	*Independent Testing Laboratory – TBD (Authorized Representative of Special Inspector)*	
5. Testing Agency	*Connecticut Department of Transportation – Division of Material Testing (or Authorized Representative)*	
6. Designer	*Wendel*	

Notes:

1. In the following table a comma means "or".
2. In the following table "and 6" means that the designer will participate to an extent to be determined.

Quality Assurance Plan

Quality Assurance for Seismic Resistance

Seismic Design Category	*B*
Quality Assurance Plan Required (Y/N)	*Yes*

Description of seismic force resisting system and designated seismic systems:

The building is designated for Seismic Category B. The building is separated by expansion joints along (between) column lines 4 & 5in north south direction. The west portions designated as A,B,C are CIP two way with post tension slab-beam framing to 1st level and structural steel framing from 1st level to roof. .The east portions designated D,E,F,& G are mainly structural steel framing with CIP walls below 1st level and composite slab at floor levels. The building foundations are spread footings on natural or structural file soil. The lateral stability systems (seismic and wind) are vary with building portions: A & C two way concrete frames and steel x-bracing above while portion B is similar to A & C with steel moment frames in E-W direction for upper section (above 1st level). The D,E,F potions have steel x-bracing framing while the portion G has combined x-bracing, moment frame, and masonry elevator shaft walls as shear walls .

Quality Assurance for Wind Requirements

Basic Wind Speed (3 second gust)	*100 mph*
Wind Exposure Category	*C*
Quality Assurance Plan Required (Y/N)	*Yes*

Description of wind force resisting system and designated wind resisting components:

Same as seismic force resisting system, above.

Statement of Responsibility

The Contractor and sub-contractor responsible for the construction or fabrication of a system or component included in the above Quality Assurance Plan must submit a Statement of Responsibility. The contractor's Statement of Responsibility form has been included.

Soils and Foundations

Item	Agency # (Qualif.)	Scope
1. Shallow Foundations	*2,4*	*Test soil under column footing before placing concrete for soil bearing pressure*
2. Controlled Structural Fill	*2,4*	*Structural Backfill shall comply with the requirements of Section #0216004A. (Periodic)*
	2,4	*Inspect placement, lift thickness and compaction of controlled fill once each day during placement. (Periodic)*
	2,4	*Test density of each lift of fill by AASHTO T180 Method D. (Periodic)*
	2,4 PE/GE	*Verify extent and slope of fill placement once each day during placement. (Periodic)*

Cast-in-Place Concrete

Item	Agency # (Qualif.)	Scope
1. Mix Design *1904, 1905.2-1905.4*	*1,2,4,5* *ACI-CCI ICC-RCSI*	*Review concrete batch tickets and verify compliance with approved mix design. Verify that water added at the site does not exceed that allowed by the mix design. ACI 318, Chapter 5. (Continuous during concrete batching)*
2. Material Certification *1704.4.1, 1708.3*	*1,2,4,5*	*Review concrete material certifications provided by the Contractor for conformance with ACI 318, Chapter 3 and Project Specifications. (Periodic)*
	2,4 ACI-CCI ICC-RCSI	*Review certified mill test reports to ensure compliance with 1708.3. (Periodic)*

3. Reinforcement Installation *1903.5.2*	*2,4* *ACI-CCI* *ICC-RCSI*	*Inspect size, spacing, cover, positioning and grade of reinforcing steel for compliance with ACI 7.5. Verify that reinforcing bars are free of form oil or other deleterious materials as required in ACI 7.4. Inspect bar laps and mechanical splices. Verify that bars are adequately tied and supported on chairs or bolsters as per ACI 7.13. (Periodic daily during rebar installation)*
4. Post-Tensioning Operations	*2,4* *ACI-CCI*	*Placement of concrete, all tests, all post tension operations including grouting shall be Continuous inspection.*
5. Welding of Reinforcing *1903.5.2*	*2,4* *AWS-CWI*	*Visually inspect all reinforcing steel welds. Verify weldability of reinforcing steel. Inspect preheating of steel when required. (Periodic)*
6. Anchor Rods *1912.5*	*2,4* *ACI-CCI* *ICC-RCSI*	*Inspect size, positioning and embedment of anchor rods. Inspect concrete placement and consolidation around anchors. (Continuous during concrete placement and consolidation around anchors)*
7. Concrete Placement *1905.9*	*2,4* *ACI-CCI* *ICC-RCSI*	*Inspect placement of concrete for conformance with ACI 5.10. Verify that concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated. (Continuous during concrete placement)*
8. Sampling and Testing of Concrete *1905.6*	*1,2,4,5* *ACI-CFTT* *ACI-STT*	*Test concrete compressive strength (ASTM C31 & C39), slump (ASTM C143), air-content (ASTM C231 or C173) and temperature (ASTM C1064). Test frequency shall be twice the minimum frequencies noted in IBC 1905.6. Test samples shall be taken on a strictly random basis. Each sample shall include four cylinders, one for 7 day strength test, two for 28 day strength test and the fourth as a spare. (Continuous during concrete batching)*
9. Curing and Protection *1905.11 – 1905.13*	*2,4* *ACI-CCI* *ICC-RCSI*	*Inspect curing, cold weather protection in compliance with IBC 1905.12 and hot weather protection for compliance with IBC 1905.13. (Periodic on daily basis when temperatures exceed limits specified)*

10. Other: Concrete Encasement of Columns	*1,2,4* *ACI-CCI* *ICC-RCSI*	*Measure each side of each encased column at bottom, middle and top to verify required two inches of cover for fire proofing. Inspect formwork prior to placement of concrete in order to verify adequate cover. (Continuous)*

Masonry

Item	**Agency # (Qualif.)**	**Scope**
1. Material Certification	*1,2,4,5* *ACI-CCI* *ICC-RCSI*	*Review all material certifications provided by Contractor for conformance with ACI 318 and Project Specifications (Periodic)*
2. Mixing of Mortar and Grout	*2,4* *ICC-SMSI*	*Inspect proportioning, mixing and retempering of mortar and grout for compliance with Specification 04 20 00 each day. (Periodic)*
3. Installation of Masonry	*2,4* *ICC-SMSI*	*Inspect size, layout, bonding and placement of masonry units for compliance with Specification 04 20 0 each day. (Periodic)*
4. Mortar Joints	*2,4* *ICC-SMSI*	*Inspect construction of mortar joints including tooling and filling of head joints for compliance with Specification 04 20 00. (Periodic)*
5. Reinforcement Installation	*2,4* *2,4* *ICC-SMSI* *AWS-CWI*	*Inspect placement, positioning and lapping of reinforcing steel for compliance with Specification 04 20 00 for all load bearing walls and partitions. (Periodic)* *Inspect all welding of reinforcing steel. (Continuous)*

6. Grouting Operations	*2,4* *ICC-SMSI*	*Inspect placement and consolidation of grout. Inspect masonry clean-outs for high-lift grouting. (Continuous during installation)*
7. Weather Protection	*2,4* *ICC-SMSI*	*Inspect cold weather protection for compliance with ACI 5.12 and hot weather protection for compliance with ACI 5.13. Use mortar within 1-1/2 hours after mixing when temperature is above 80ºF. Verify that wall cavities are protected against precipitation. (Periodic)*
8. Evaluation of Masonry Strength	*2,4,5*	*Test compressive strength of mortar and grout cube samples taken at a rate of one sample per 200 square feet of masonry but no less than once per day. (ASTM C780). (Continuous)*
9. Anchors and Ties	*2,4* *ICC-*	*Inspect size, location, spacing and embedment of dowels, anchors and ties. (Continuous)*
10. Other: *Basis of Inspections*	*2,4*	*Perform inspections in accordance with Table 1704.5.3 for Level 2.*

Structural Steel

Item	**Agency # (Qualif.)**	**Scope**
1. Fabricator Certification/ Quality Control Procedures *1704.2* ☐ Fabricator Exempt	*1,2,5* *2,4,5* *AWS/AISC -SSI* *ICC-SWSI*	*Verify use of Department approved steel fabricator that participates in the AISC quality certification program and has a certified plant in Category STD. (Periodic)* *Review shop fabrication and quality control procedures. (Periodic)*

2. Material Certification	*1,2,4,5* *AWS/AISC -SSI* *ICC-SWSI*	*Review certified mill test reports and identification markings on wide-flange shapes, high-strength bolts, nuts and welding electrodes (Periodic)*
3. Open Web Steel Joists	*2,4* *AWS/AISC -SSI* *2,4 and 6*	*Inspect installation, field welding and bridging of joists for compliance with requirements of the Steel Joist Institute. (Periodic)* *Review proposed connections to ensure conformance with Contract Documents. (Periodic)*
4. Bolting *1704.3.3*	*2,4 and 6* *2,4,5* *2,4,5* *2,4,5* *AWS/AISC -SSI* *ICC-SWSI*	*Review and approve certification for calibrating device used to set the calibration wrenches for high strength bolts. Recertify the calibrating device at six month intervals. (Periodic)* *Inspect installation and tightening of high-strength bolts. Verify compliance with AISC Specifications for Structural Joints using ASTM A 325 or A 490 Bolts. (Periodic)* *Visually ensure that the plies of the connected elements in snug-tightened joints have been brought into contact and washers installed as required. (Periodic)* *For slip critical or friction type joints, the inspectors shall observe a pre-installation verification testing of the fastener assemblies for the method chosen by the contractor. This shall be followed by monitoring of the work and randomly testing a minimum of one percent of the bolts and at least two bolts per day of installation for proper applied tension. (Continuous)*

5. Welding *1704.3.1, 1707.2*	*2,4,5* *2,4* *2,4* *2,4* *2,4* *AWS-CWI*	*Verify that all welders have passed AWS qualification tests within the past 12 months and meet the requirements of Article 6.03.03, section 6, subsection (a) of the Form 816. (Periodic)* *Visually inspect all welds to verify criteria in AWS Table 6.1 are satisfied. Inspect pre-heat, post-heat and surface preparation between passes. Verify size and length of fillet welds. (Continuous)* *Full penetration shop welds shall be non-destructively tested by radiographic method to verify compliance with the requirements of AWS Section 6.12.1. (Peridoic)* *Full-penetration welds field welds shall be non-destructively tested by ultrasonic methods to verify compliance with the requirements of AWS 6.13.1 and Table 6.2. (Continuous)* *Partial penetration and fillet welds shall be tested nondestructively by magnetic particle method. The first 10 such welds produced by each individual welder shall be so tested. If these test results are acceptable to the inspector, thereafter 15% of the welds completed by each welder will be tested. If such further testing results in two or more unacceptable welds, that welder will have the next 15 welds tested. If the test results are acceptable to the inspector, testing defaults back to 15% of their welds. If the test results are unacceptable, that welder will not be allowed to continue on the project. (Periodic)*
6. Shear Connectors *1903.5.2*	*2,4* *AWS/AISC -SSI ICC-SWSI*	*Inspect size, number, positioning and welding of shear connectors. Inspect studs for full 360 degree flash. Ring test all shear connectors with a 3 lb hammer. Bend test all questionable studs to 15 degrees. (Continuous)*

7. Structural Details	*6* *2,3,4 and 6* *PE/SE*	*Review all shop drawings to verity conformance with Contract Documents. (Periodic)* *Inspect installation and field procedures to ensure conformance with approved shop drawing and structural drawings, including bracing, member configuration and connection details. (Periodic)*
8. Metal Deck	*2,4* *AWS-CWI*	*Inspect installation, welding and side-lap fastening of metal roof and floor deck to verify conformance with Contract Documents. (Periodic)*

Cold-Formed Steel Framing

Item	**Agency # (Qualif.)**	**Scope**
1. Member Sizes	*6* *PE/SE*	*Review shop drawings for girt system supporting the exterior wall finish system. (Periodic)*
2. Material Thickness	*2,4* *ICC-SWSI*	*Inspect materials for conformance with approved shop drawings. (Periodic)*
3. Material Properties	*2,4* *ICC-SWSI*	*Inspect elements for material identification markings and or manufacturer's designation for conformance with approved shop drawings. (Periodic)*
4. Mechanical Connections	*2,4* *ICC-SWSI*	*Inspect connections for conformance with approved shop drawings. (Continuous)*

5. Welding	*2,4* *2,4* *ICC-SWSI*	*Perform visual inspection and ultrasonic testing of at least 10% of welded joints. (Periodic)* *Inspect welds in shop and field. (Periodic)*
6. Framing Details *1707.4*	*2,4* *ICC-SWSI*	*Inspections of welding and fastening of components. (Periodic)*

<u>Architectural Systems</u>

Item	**Agency # (Qualif.)**	**Scope**
1. Wall Panels & Veneers *1707.6*	*6* *2,4* *PE/SE*	*Review of shop drawings for fabricated wall panel system. (Periodic)* *Inspect installation of fabricated wall panel system to ensure conformance with Contract Documents and approved shop drawings. (Periodic)*
2. Suspended Ceilings	*6* *2,4* *PE/SE*	*Review shop drawings for acoustical ceilings to ensure compliance with Contract Documents (Periodic)* *Inspect the installation of acoustical ceilings in Category D areas to ensure compliance with Contract Documents and approved shop drawings. (Periodic)*

3. Window and Door Assemblies, Roofing and Exterior Insulated Steel Panel System	*6*	*Review shop drawings for window and door assemblies, roofing and exterior insulated steel panel system. (Periodic)*
	2,4	*Verify condition of substrates before installation of finish elements in entire building. Periodic)*
	2,4	*Inspect flashing and joint details in entire building for conformance with Contract Documents and approved Shop Drawings. (Periodic)*
	2,4 EDI-EIFS	*Inspect installation of sealants and caulks in entire building for conformance with Contract Documents and approved Shop Drawings. (Periodic)*
4. Other: South Entry Facade *1704.13*	*6*	*Review shop drawings for structural elements, glass, and insulated metal panel for south entry façade to ensure conformance to Contract Documents. (Continuous)*
	1,2,4	*Inspect construction of south entry façade to ensure compliance with Contract Documents and approved shop drawings. (Continuous)*
	PE/SE	

The contractor is advised that the attached *Final Report of Special Inspections* certifying that all of the required inspections and tests have been completed and that all identified deficiencies have been corrected or resolved, must be completed by the Special Inspection Coordinator responsible for managing and coordinating the inspection and testing program on this facility.

Contractor's Statement of Responsibility

Each contractor responsible for the construction or fabrication of a system or component designated in the Quality Assurance Plan must submit a Statement of Responsibility.

Project:

Contractor's Name:

Address:

License No.:

Description of designated building systems and components included in the Statement of Responsibility:

Contractor's Acknowledgment of Special Requirements

I hereby acknowledge that I have received, read, and understand the Quality Assurance Plan and Special Inspection program.

I hereby acknowledge that control will be exercised to obtain conformance with the construction documents approved by the Building Official.

_____ _____

Signature Date

Contractor's Provisions for Quality Control

Procedures for exercising control within the contractor's organization, the method and frequency of reporting and the distribution of reports is attached to this Statement.

Identification and qualifications of the person(s) exercising such control and their position(s) in the organization are attached to this Statement.

Final Report of Special Inspections

Project:

Location:

Owner:

Owner's Address:

Architect of Record:

Structural Engineer of Record:

To the best of my information, knowledge and belief, the Special Inspections required for this project, and itemized in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved other than the following:

Comments:

(Attach continuation sheets if required to complete the description of corrections.)

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,
Special Inspector

(Type or print name)

Signature Date

Licensed Professional Seal

Final Report of Special Inspections

Agent's Final Report

Project:

Agent:

Special Inspector:

To the best of my information, knowledge and belief, the Special Inspections or testing required for this project, and designated for this Agent in the *Statement of Special Inspections* submitted for permit, have been performed and all discovered discrepancies have been reported and resolved other than the following:

Comments:

(Attach continuation sheets if required to complete the description of corrections.)

Interim reports submitted prior to this final report form a basis for and are to be considered an integral part of this final report.

Respectfully submitted,
Agent of the Special Inspector

(Type or print name)

Signature Date

Licensed Professional Seal or Certification

NOTICE TO CONTRACTOR – CAD FILES

The Contractor is hereby advised that the Department will provide CAD Files to the Contractor (upon request) in Revit 2013 and AutoCad format for their use during the construction of the Project. The Contractor shall make such request to the Engineer, and the Designer will provide the CAD Files within 14 calendar days.

The Contractor shall bid the Project accordingly.

Welcome
to the
Connecticut Department of Transportation
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If the Receiver proceeds, the Receiver agrees to the following terms and conditions:

1. The State of Connecticut, Department of Transportation (hereinafter referred to as ConnDOT) makes no warranty of any kind, express or implied, with respect to the file(s) which are the subject of this agreement, and specifically makes no warranty that said file(s) shall be merchantable or fit for any particular purpose. Furthermore, any description of said file(s) shall not be deemed to create an express warranty that such files shall conform to said description. The exhibition of any sample or model shall not be regarded as part of the basis of this agreement and shall not create an express warranty that the whole of the file(s) provided hereunder shall conform to any sample or model.

2. Receiver assumes all risk and liability for any losses, damages, claims or expenses resulting from the use, possession or resale of any file(s) furnished by ConnDOT pursuant to this agreement.

3. Receiver agrees to indemnify, defend and hold harmless ConnDOT, its officers, agents, and employees from and against any and all claims, suits, losses, damages or costs, including reasonable attorney's fees, arising from or by reason of receivers' use, possession or resale with respect to any of the file(s) furnished by ConnDOT pursuant to this agreement, and such indemnification shall survive acceptance of said file(s) by receiver.

4. Receiver agrees that it will not advertise, order for resale, or sell the file(s) furnished hereunder.

5. Receiver agrees that the ConnDOT has made every reasonable effort to provide information in a file format which offers cross-platform solutions (for both application and file compression). Some ConnDOT files are compressed. Compressed files can be identified by a file extension, (e.g., .sit, .bin, .hqx, .zip or .arc).

6. Receiver agrees that ConnDOT cannot be held responsible for problems arising from files which have been converted for use in non-native applications (e.g. Microsoft Word documents read in WordPerfect, Microstation design files to Autocad).

7. Receiver agrees that ConnDOT cannot provide the files in other file or compression formats, and agrees to use the files in the format provided.

8. These terms and conditions constitute the complete and final agreement of the parties hereto.

Receiver <u>ACCEPTS</u> the aforementioned terms and conditions.

SIGNATURE:_____ DATE:_____

NOTICE TO CONTRACTOR – FLOOD CONTINGENCY PLAN

Construction Operation Plan - During construction, the Contractor is bound by the conditions set forth in "Standard Specifications for Roads, Bridges and Incidental Construction", Form 816 including the supplemental specifications. Specifically, Section 1.10 - Environmental Compliance, addresses the need for the Contractor to maintain a stable work area and to coordinate with the National Oceanic and Atmospheric Administration (N.O.A.A.) weather service for information pertaining to storms. These provisions are fully described under Items 9 and 10 of the "Best Management Practices."

The Contractor is advised that portions of the sitefall within the 100-year and 500-year flood zone. Storage of materials that could be injurious to human health or the environment in the event of flooding will be located outside of the 100-year flood zone. Other material or equipment may be stored below the 500 year flood elevation such that the material or equipment is not subject to major damage by floods, and that such material or equipment will be firmly anchored, restrained or enclosed to prevent it from floating away or that such material or equipment can be removed prior to flooding.

NOTICE TO CONTRACTOR – FM GLOBAL SUBMITTALS

Copies of the following submittals requiring FM Global review for conformance with the Contract shall be transmitted to the Designer in accordance with NOTICE TO CONTRACTOR - SUBMITTALS.

1. 05 31 00, “Steel Decking”
2. 07 42 13, “Metal Wall Panels”
3. 07 54 23, “Thermoplastic Polyolefin (TPO) Roofing”
4. 07 71 00, “Roof Specialties”
5. 07 81 23, “Intumescent Fireproofing”
6. 07 84 13, “Penetration Firestopping”
7. 07 84 46, “Fire Resistive Joint Systems”
8. 08 11 13, “Hollow Metal Doors and Frames”
9. 08 33 23, “Overhead Coiling Doors”
10. 08 36 13, “Sectional Doors”
11. 08 41 13, “Aluminum Framed Entrances and Storefronts”
12. 08 44 13, “Glazed Aluminum Curtain Walls”
13. 08 62 00, “Unit Skylights”
14. 08 80 00, “Glazing”
15. 11 14 00, “ Fuel and Fluid Management”
16. 11 51 00, “Shop Equipment”
17. 11 56 00, “Fueling System Equipment”
18. 21 05 23, “General Duty Valves for Water Based Fire Suppression Piping”
19. 21 12 00, “Fire Suppression Standpipes”
20. 21 13 13, “Wet Pipe Sprinkler Systems”
21. 21 13 16, “Dry Pipe Sprinkler Systems”
22. 22 11 19, “Domestic Water Piping Specialties”
23. 23 05 23, “Valves”
24. 23 05 29, “Supports and Anchors”
25. 23 52 16, “Condensing Boilers”.
26. 23 72 00, “Air-To-Air Energy Recovery Units”
27. 26 41 13, “Lightning Protection System”.
28. 28 31 00, “Voice Communication Fire Alarm and Detection System”.
29. 33 10 00, “Water Distribution System”.

The following FM Global forms are required to be submitted by the Contractor:

FORM NO.	**FORM DESCRIPTION**
1-28	DESIGN WIND LOADS
1-29	ROOF DECK SECUREMENT AND ABOVE-DECK ROOF COMPONENTS
1-45	AIR CONDITIONING AND VENTILATING SYSTEM
1-49	PERIMETER FLASHING
1-54	ROOF LOADS FOR NEW CONSTRUCTION
1-57	PLASTICS IN CONSTRUCTION
2-8N	NFPA 13 STANDARD FOR THE INSTALLATION OF SPRINKLER SYSTEMS 1996 EDITION
3-10	INSTALLATION AND MAINTENANCE OF PRIVATE FIRE SERVICE MAINS AND THEIR APPURTENANCES
3-26	FIRE PROTECTION WATER DEMAND FOR NONSTORAGE SPRINKLERED PROPERTIES
5-4	TRANSFORMERS
5-11	LIGHTING AND SURGE PROTECTION FOR ELECTRICAL SYSTEMS
5-19	SWITCHGEAR AND CIRCUIT BREAKERS
5-23	EMERGENCY AND STANDBY POWER SYSTEMS
5-48	AUTOMATIC FIRE DETECTION
85A	CONTRACTOR'S MATERIAL & TEST CERTIFICATE FOR ABOVEGROUND PIPING
85B	CONTRACTOR'S MATERIAL & TEST CERTIFICATE FOR UNDERGROUND PIPING
2332	CONTRACTOR'S APPLICATION FOR ACCEPTANCE OF GASEOUS EXTINGUISHING SYSTEM INSTALLATION
2688	APPLICATION FOR ACCEPTANCE OF ROOF SYSTEM

The above lists may not be all-inclusive and do not relieve the Contractor from its responsibility to provide FM Global with other submittals or forms for approval as may be required elsewhere in the Contract Documents.

NOTICE TO CONTRACTOR – UNDERGROUND UTILITIES

The work to be accomplished under this Contract is to be performed both within and outside of the CTDOT right-of-way. Call-Before-You-Dig (CBYD) does not coordinate the mark out of any underground utilities located outside of the right-of-way. The Contractor is responsible for locating all other utilities throughout the project sites, prior to performing any excavations.

NOTICE TO CONTRACTOR – USE OF STATE PROPERTY

Use of State property by the Contractor for purposes other than the construction activities included in this Contract requires advance approval from the Engineer.

This applies to activities including, but not limited to: Staging and storage areas, screening/crushing operations, asphalt or concrete plants, gravel/borrow pits, and other manufacturing and/or mining operations.

The bulk storage of fuels and lubricants shall not be permitted on State property.

The storage of hazardous materials, other than those associated with the Contractor's Project related operations, shall not be permitted on State property. The Contractor shall assume sole responsibility for the proper storage, handling, management, and disposal of hazardous materials. All remedial and punitive costs incurred by the Department as a result of the Contractor's failure to properly manage hazardous materials shall be borne by the Contractor.

The Contractor is cautioned that environmental testing of the site may be required at the Contractor's expense both prior to and upon completion of the use of the State property. The Contractor shall be responsible for restoring the site and removal of all contaminants which may have been deposited at the site during its use. The Contractor must conform to the Department's Best Management Practices, environmental permit conditions and other applicable State and federal regulations. The use and restoration of the site will be at no cost to the State of Connecticut. The use of the site will be for this specific DOT Project only. In addition, approval or denial of such request shall not be used as a reason for any time extensions or claim.

For Staging and Storage Areas

The Contractor must submit all requests for the temporary use of any State property in writing to the Engineer. The following minimum information shall be included with the request(s): a description of the proposed operation or use of the site; a site plan detailing the location of the proposed operation/use, and sedimentation and erosion controls; an area plan detailing ingress and egress to the site and proximity to residential and/or occupied buildings; copies of any required environmental permits; and planned hours of operation. The submittal shall also include photo documentation (minimum of 12 each, 8"x10" color photos) showing the preconstruction condition of the site and adjacent property at the site boundaries. If the site is State property outside of the DOT right of way, authorization from other State Agencies will also be required for use of the property or site.

For Use Other than Construction Staging and Storage Areas

The Contractor must submit all requests for the temporary use of any State property in writing to the Engineer. The request(s) shall include the same information required for storage and staging areas. In addition, the Contractor will be required to provide written confirmation that the municipality in which the site is located does not object to the proposed use of the State property. The Contractor will be required to execute a license agreement with the Department for use of State property for other than staging and storage areas.

For asphalt batching or continuous mix facilities, the Contractor shall also provide a map detailing the outer most perimeter of the facility showing all structures, land use, watercourses, wetlands, and areas of environmental concern with one-third mile of the facility perimeter. No such facility will be permitted on State property where any hospital, nursing home, school, area of critical environmental concern, watercourses, or residential housing exists within one-third mile of the perimeter of the facility (P.A. 98-216).

NOTICE TO CONTRACTOR - SECTION 4.06 - BITUMINOUS CONCRETE

Section 4.06 is being deleted in its entirety and replaced with the following:

4.06.01—Description
4.06.02—Materials
4.06.03—Construction Methods
4.06.04—Method of Measurement
4.06.05—Basis of Payment

4.06.01—Description: Work under this section shall include the production, delivery and placement of a non-segregated, smooth and dense bituminous concrete mixture brought to proper grade and cross section. This section shall also include the method and construction of longitudinal joints. The Contractor shall furnish ConnDOT with a Quality Control Plan as described in Article 4.06.03.

The terms listed below as used in this specification are defined as:

Bituminous Concrete: A concrete material that uses a bituminous material (typically asphalt) as the binding agent and stone and sand as the principal aggregate components. Bituminous concrete may also contain any of a number of additives engineered to modify specific properties and/or behavior of the concrete material. For the purposes of this Specification, references to bituminous concrete apply to all of its sub-categories, for instance those defined on the basis of production and placement temperatures, such as hot-mix asphalt (HMA) or warm-mix asphalt (WMA), those categories derived from the mix-design procedure used, such as "Marshall" mixes or "Superpave" mixes, or those defined on the basis of composition, such as polymer-modified asphalt (PMA).

Course: A lift or multiple lifts comprised of the same bituminous concrete mixture placed as part of the pavement structure.

Density Lot: All material placed in a single lift and as defined in Article 4.06.03.

Disintegration: Wearing away or fragmentation of the pavement. Disintegration will be evident in the following forms: Polishing, weathering-oxidizing, scaling, spalling, raveling, potholes or loss of material.

Dispute Resolution: A procedure used to resolve conflicts resulting from discrepancies between the Engineer and the Contractor's density results that may affect payment.

Hot Mix Asphalt (HMA): A bituminous concrete mixture typically produced at 325°F.

Lift: An application of a bituminous concrete mixture placed and compacted to a specified thickness in a single paver pass.

Marshall: A bituminous concrete mix design used in mixtures designated as "Bituminous Concrete Class ( )".

Polymer Modified Asphalt (PMA): A bituminous concrete mixture containing a polymer modified asphalt binder in accordance with contract specifications.

Production Lot: All material placed during a continuous daily paving operation.

Quality Assurance (QA): All those planned and systematic actions necessary to provide confidence that a product or facility will perform as designed.

Quality Control (QC): The sum total of activities performed by the vendor (Producer, Manufacturer, and Contractor) to ensure that a product meets contract specification requirements.

Superpave: A bituminous concrete mix design used in mixtures designated as "S*" Where "S" indicates Superpave and * indicates the sieve related to the nominal maximum aggregate size of the mix.

Segregation: A non-uniform distribution of a bituminous concrete mixture in terms of volumetrics, gradation or temperature.

Warm Mix Asphalt (WMA): A bituminous concrete mixture that can be produced and placed at reduced temperatures than HMA using a qualified additive or technology.

4.06.02—Materials: All materials shall conform to the requirements of Section M.04.

1. Materials Supply: The bituminous concrete mixture must be from one source of supply and originate from one Plant unless authorized by the Engineer. Bituminous Concrete plant QC plan requirements are defined in Section M.04.

2. Recycle Option: The Contractor has the option of recycling reclaimed asphalt pavement (RAP) or Crushed Recycled Container Glass (CRCG) in bituminous concrete mixtures in accordance with Section M.04. CRCG shall not be used in the final lift of the surface course.

4.06.03—Construction Methods:

1. Material Documentation: All vendors producing bituminous concrete must have their truck-weighing scales, storage scales, and mixing plant automated to provide a detailed ticket.

Delivery tickets must include the following information:

a. State of Connecticut printed on ticket.
b. Name of producer, identification of plant, and specific storage bin (silo) if used.
c. Date and time of day.

d. Mixture Designation If RAP is used, the plant printouts shall include RAP dry weight, percentage and daily moisture content. If WMA technology is used, the technology and the additive rate or the water injection rate must be noted on the ticket. Class 3 mixtures for machine-placed curbing must state "curb mix only".
e. Net weight of mixture loaded into truck (When RAP is used, RAP moisture shall be excluded from mixture net weight).
f. Gross weight (Either equal to the net weight plus the tare weight or the loaded scale weight).
g. Tare weight of truck – Daily scale weight.
h. Project number, purchase order number, name of Contractor (if Contractor other than Producer).
i. Truck number for specific identification of truck.
j. Individual aggregate, RAP, and virgin asphalt high/target/low weights shall be printed on batch plant tickets (For drum plants and silo loadings, the plant printouts shall be printed out at 5 minute intervals maintained by the vendor for a period of three years after the completion of the project).
k. For every mixture designation the running daily total delivered and sequential load number.

The net weight of mixture loaded into the truck must be equal to the cumulative measured weight of its components.

The Contractor must notify the Engineer immediately if, during the production day, there is a malfunction of the weighing or recording system in the automated plant or truck-weighing scales. Manually written tickets containing all required information will be allowed for one hour, but for no longer, provided that each load is weighed on State-approved scales. At the Engineer’s sole discretion, trucks may be approved to leave the plant if a State inspector is present to monitor weighing. If such a malfunction is not fixed within forty-eight hours, mixture will not be approved to leave the plant until the system is fixed to the Engineer's satisfaction. No damages will be considered should the State be unable to provide an inspector at the plant.

The State reserves the right to have an inspector present to monitor batching and /or weighing operations.

2. Transportation of Mixture: Trucks with loads of bituminous concrete being delivered to State projects must not exceed the statutory or permitted load limits referred to as gross vehicle weight (GVW). The Contractor shall furnish a list of all vehicles and allowable weights transporting mixture.

The State reserves the right to check the gross and tare weight of any delivery truck. A variation of 0.4 percent or less in the gross or tare weight shown on the delivery ticket and the certified scale weight shall be considered evidence that the weight shown on the delivery ticket is correct. If the gross or tare weight varies from that shown on the delivery ticket by more than 0.4 percent, the Engineer will recalculate the net weight. The Contractor shall take action to correct discrepancy to the satisfaction of the Engineer.

If a truck delivers mixture to the project and the ticket indicates that the truck is overweight, the load will not be rejected but a "Measured Weight Adjustment" will be taken in accordance with Article 4.06.04.

The mixture shall be transported from the mixing plant in trucks that have previously been cleaned of all foreign material and that have no gaps through which mixture might inadvertently escape. The Contractor shall take care in loading trucks uniformly so that segregation is minimized. Loaded trucks shall be tightly covered with waterproof covers acceptable to the Engineer. Mesh covers are prohibited. The front and rear of the cover must be fastened to minimize air infiltration. The Contractor shall assure that all trucks are in conformance with this specification. Trucks found not to be in conformance shall not be allowed to be loaded until re-inspected to the satisfaction of the Engineer.

Truck body coating and cleaning agents must not have a deleterious effect on the transported mixture. The use of solvents or fuel oil, in any concentration, is strictly prohibited for the coating of the inside of truck bodies. When acceptable coating or agents are applied, truck bodies shall be raised immediately prior to loading to remove any excess agent in an environmentally acceptable manner.

3. Paving Equipment: The Contractor shall have the necessary paving and compaction equipment at the project site to perform the work. All equipment shall be in good working order and any equipment that is worn, defective or inadequate for performance of the work shall be repaired or replaced by the Contractor to the satisfaction of the Engineer. During the paving operation, the use of solvents or fuel oil, in any concentration, is strictly prohibited as a release agent or cleaner on any paving equipment (i.e., rollers, pavers, transfer devices, etc.).

Refueling of equipment is prohibited in any location on the paving project where fuel might come in contact with bituminous concrete mixtures already placed or to be placed. Solvents for use in cleaning mechanical equipment or hand tools shall be stored clear of areas paved or to be paved. Before any such equipment and tools are cleaned, they shall be moved off the paved or to be paved area; and they shall not be returned for use until after they have been allowed to dry.

Pavers: Each paver shall have a receiving hopper with sufficient capacity to provide for a uniform spreading operation and a distribution system that places the mix uniformly, without segregation. The paver shall be equipped with and use a vibratory screed system with heaters or burners. The screed system shall be capable of producing a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture. Pavers with extendible screed units as part of the system shall have auger extensions and tunnel extenders as necessary. Automatic screed controls for grade and slope shall be used at all times unless otherwise authorized by the Engineer. The controls shall automatically adjust the screed to compensate for irregularities in the preceding course or existing base. The controls shall maintain the proper transverse slope and be readily adjustable, and shall operate from a fixed or moving reference such as a grade wire or floating beam.

Rollers: All rollers shall be self-propelled and designed for compaction of bituminous concrete. Rollers types shall include steel-wheeled, pneumatic or a combination thereof and may be capable of operating in a static or dynamic mode. Rollers that operate in a dynamic mode shall have drums that use a vibratory or oscillatory system or combination of. The vibratory system achieves compaction through vertical amplitude forces. Rollers with this system shall be equipped with indicators that provide the operator with amplitude, frequency and speed settings/readouts to measure the impacts per foot during the compaction process. The oscillatory system achieves compaction through horizontal shear forces. Rollers with this system shall be equipped with frequency indicators. Rollers can operate in the dynamic mode using the oscillatory system on concrete structures such as bridges and catch basins if at the lowest frequency setting.

Pneumatic tire rollers shall be self-propelled and equipped with wide-tread compaction tires capable of exerting an average contact pressure from 60 to 90 pounds per square inch uniformly over the surface, adjusting ballast and tire inflation pressure as required. The Contractor shall furnish evidence regarding tire size; pressure and loading to confirm that the proper contact pressure is being developed and that the loading and contact pressure are uniform for all wheels.

Material Transfer Vehicle (MTV): A MTV shall be used when placing a bituminous concrete surface course as indicated in the contract documents. A surface course is defined as the total thickness of the same bituminous concrete mix that extends up to and includes the final wearing surface whether it is placed in a single or multiple lifts, and regardless of any time delays between lifts.

The MTV must be a self-propelled vehicle specifically designed for the purpose of delivering the bituminous concrete mixture from the delivery truck to the paver. The MTV must have the capability to remix the bituminous concrete mixture.

The use of a MTV will be subject to the requirements stated in Article 1.07.05- Load Restrictions. The Engineer may limit the use of the vehicle if it is determined that the use of the MTV may damage highway components, utilities, or bridges. The Contractor shall submit to the Engineer at time of pre-construction the following information:

- The make and model of the MTV to be used.
- The individual axle weights and axle spacing for each separate piece of paving equipment (haul vehicle, MTV and paver).
- A working drawing showing the axle spacing in combination with all three pieces of equipment that will comprise the paving echelon.

4. Seasonal Requirements: Paving, including placement of temporary pavements, shall be divided into two seasons, In-Season and Extended Season. In-Season paving shall occur from May 1 – October 14, and Extended Season shall occur from October 15- April 30. The following requirements shall apply unless otherwise authorized or directed by the Engineer:

- Bituminous concrete mixes shall not be placed when the air or subbase temperature is below 40°F regardless of the season.
- Should paving operations be scheduled during the Extended Season, the Contractor's Quality Control Plan for placement described in Section 9. "Contractor Quality Control Plan for Placement" shall include a separate section titled "Extended Season Paving" and address minimum delivered mix temperature, maximum paver speed, enhanced rolling patterns and the method to balance mixture delivery and placement operations. Work covered by the section on Extended Season paving shall not commence until the Engineer's comments have been incorporated into the section and approved.
- Should placement of the final lift of bituminous concrete be scheduled during the Extended Season, the Contractor is required to submit this plan to the Engineer for review 30 days prior to the paving operation.

5. Superpave Test Section: The Engineer may require the Contractor to place a test section whenever the requirements of this specification or Section M.04 are not met.

The Contractor shall submit the quantity of mixture to be placed and the location of the test section for review and acceptance by the Engineer. The equipment used in the construction of a passing test section shall be used throughout production.

If a test section fails to meet specifications, the Contractor shall stop production, make necessary adjustments to the job mix formula, plant operations, or procedures for placement and compaction. The Contractor shall construct test sections, as allowed by the Engineer, until all the required specifications are met. All test sections shall also be subject to removal as set forth in Article 1.06.04.

6. Transitions for Roadway Surface: Transitions shall be formed at any point on the roadway where the pavement surface deviates, vertically, from the uniform longitudinal profile as specified on the plans. Whether formed by milling or by bituminous concrete mixture, all transition lengths shall conform to the criteria below unless otherwise specified.

<u>Permanent Transitions</u>: A permanent transition is defined as any transition that remains as a permanent part of the work. All permanent transitions, leading and trailing ends shall meet the following length requirements:

a) Posted speed limit is greater than 35 MPH: 30 feet per inch of vertical change (thickness)
b) Posted speed limit is 35 MPH or less: 15 feet per inch of vertical change (thickness).
c) Bridge Overpass and underpass transition length will be 75 feet either
    (1) Before and after the bridge expansion joint, or
    (2) Before or after the parapet face of the overpass.

In areas where it is impractical to use the above described permanent transition lengths the use of a shorter permanent transition length may be permitted when approved by the Engineer.

Temporary Transitions: A temporary transition is defined as a transition that does not remain a permanent part of the work. All temporary transitions shall meet the following length requirements:

a) Posted speed limit is greater than 35 MPH
   (1) Leading Transitions = 15 feet per inch of vertical change (thickness)
   (2) Trailing Transitions = 6 feet per inch of vertical change (thickness)

b) Posted speed limit is 35 MPH or less
   (1) Leading and Trailing = 4 feet per inch of vertical change (thickness)

Note: Any temporary transition to be in-place over the winter shutdown period, holidays, or during extended periods of inactivity (more than 7 calendar days) shall conform to the "Permanent Transition" requirements shown above.

7. Spreading and Finishing of Mixture: Prior to the placement of the bituminous concrete, the underlying base course shall be brought to the plan grade and cross section within the allowable tolerance. Immediately before placing the mixture, the area to be surfaced shall be cleaned by sweeping or by other means acceptable to the Engineer. The bituminous concrete mixture shall not be placed whenever the surface is wet or frozen. The Engineer will verify the mix temperature by means of a probe or infrared type of thermometer. A probe type thermometer, verified by the Department on an annual basis, must be used in order to reject a load of mixture based on temperatures outside the range stated in the placement QC plan.

Placement: The bituminous concrete mixture shall be placed and compacted to provide a smooth, dense surface with a uniform texture and no segregation at the specified thickness and dimensions indicated in the plans and specifications.

When unforeseen weather conditions prevent further placement of the mix, the Engineer is not obligated to accept or place the bituminous concrete mixture that is in transit from the plant.

In advance of paving, traffic control requirements shall be set up daily, maintained throughout placement, and shall not be removed until all associated work including density testing is completed.

The Contractor shall inspect the newly placed pavement for defects in the mixture or placement before rolling is started. Any deviation from standard crown or section shall be immediately remedied by placing additional mixture or removing surplus mixture. Such defects shall be corrected to the satisfaction of the Engineer.

Where it is impractical due to physical limitations to operate the paving equipment, the Engineer may permit the use of other methods or equipment. Where hand spreading is permitted, the mixture shall be placed by means of suitable shovels and other tools, and in a uniformly loose layer at a thickness that will result in a completed pavement meeting the designed grade and elevation.

Placement Tolerances: Each lift of bituminous concrete placed at a uniform specified thickness shall meet the following requirements for thickness and area. Any pavement exceeding these

limits shall be subject to an adjustment or removal. Lift tolerances will not relieve the Contractor from meeting the final designed grade. Lifts of specified non-uniform thickness, i.e. wedge or shim course, shall not be subject to thickness and area adjustments.

a) Thickness- Where the total thickness of the lift of mixture exceeds that shown on the plans beyond the tolerances shown in Table 4.06-3, the longitudinal limits of such variation including locations and intervals of the measurements will be documented by the Engineer for use in calculating an adjustment in accordance with Article 4.06.04.

TABLE 4.06-3 Thickness Tolerances

Mixture Designation	Lift Tolerance
Class 4 and S1	+/- ⅜ inch
Class 1, 2 and 12 and S0.25, S0.375, S0.5	+/- ¼ inch

Where the thickness of the lift of mixture is less than that shown on the plans beyond the tolerances shown in Table 4.06-3, the Contractor, with the approval of the Engineer, shall take corrective action in accordance with this specification.

b) Area- Where the width of the lift exceeds that shown on the plans by more than the specified thickness of each lift, the longitudinal limits of such variation including locations and intervals of the measurements will be documented by the Engineer for use in calculating the adjustment in Article 4.06.04.

c) Delivered Weight of Mixture - When the delivery ticket shows that the truck exceeds the allowable gross weight for the vehicle type the quantity of tons representing the overweight amount will be documented by the Engineer for use in calculating an adjustment in accordance with Article 4.06.04.

Transverse Joints: All transverse joints shall be formed by saw-cutting a sufficient distance back from the previous run, existing bituminous concrete pavement or bituminous concrete driveways to expose the full thickness of the lift. A brush of tack coat shall be used on any cold joint immediately prior to additional bituminous concrete mixture being placed.

Tack Coat Application: A thin uniform coating of tack coat shall be applied to the pavement immediately before overlaying and be allowed sufficient time to break (set). All surfaces in contact with the bituminous concrete that have been in place longer than 3 calendar days shall have an application of tack coat. The tack coat shall be applied by a non-gravity pressurized spray system that results in uniform overlapping coverage at an application rate of 0.03 to 0.05 gallons per square yard for a non-milled surface and an application rate of 0.05 to 0.07 gallons per square yard for a milled surface. For areas where both milled and un-milled surfaces occur, the tack coat shall be an application rate of 0.03 to 0.05 gallons per square yard. The Engineer must approve the equipment and the method of measurement prior to use. The material for tack coat shall not be heated in excess of 160°F and shall not be further diluted.

Compaction: The Contractor shall compact the mixture to meet the density requirements as stated in Article 4.06.03 and eliminate all roller marks without displacement, shoving, cracking, or aggregate breakage.

The Contractor shall only operate rollers in the dynamic mode using the oscillatory system at the lowest frequency setting on concrete structures such as bridges and catch basins. The use of the vibratory system on concrete structures is prohibited. Rollers operating in the dynamic mode shall be shut off when reversing directions.

If the Engineer determines that the use of compaction equipment in the dynamic vibratory mode may damage highway components, utilities, or adjacent property, the Contractor shall provide alternate compaction equipment. The Engineer may allow the Contractor to operate rollers in the dynamic mode using the oscillatory system at the lowest frequency setting.

These allowances will not relieve the Contractor from meeting pavement compaction requirements.

Surface Requirements: The pavement surface of any lift shall meet the following requirements for smoothness and uniformity. Any irregularity of the surface exceeding these requirements shall be corrected by the Contractor.

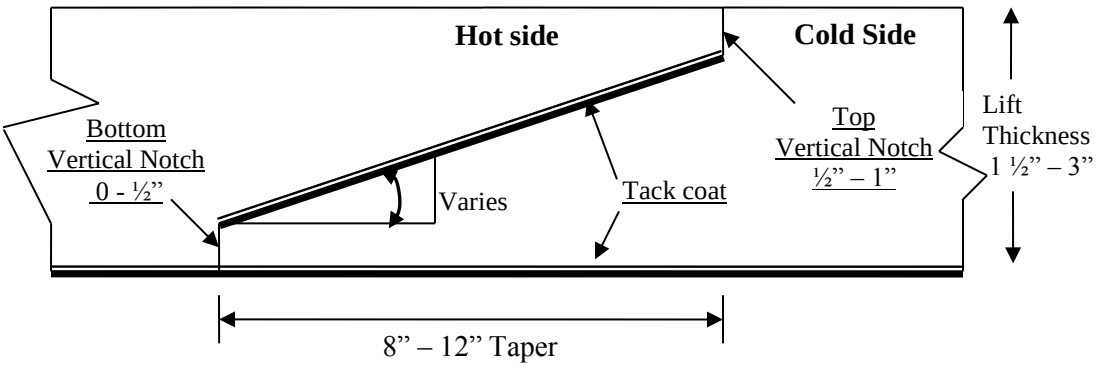
a) Smoothness- Each lift of the surface course shall not vary more than ¼ inch from a Contractor-supplied 10 foot straightedge. For all other lifts of bituminous concrete, the tolerance shall be ⅜ inch. Such tolerance will apply to all paved areas.

b) Uniformity- The paved surface shall not exhibit segregation, rutting, cracking, disintegration, flushing or vary in composition as determined by the Engineer.

8. Longitudinal Joint Construction Methods: Unless noted on the plans or the contract documents or directed by the Engineer, the Contractor shall use Method I- Notched Wedge Joint (see figure 4.06-1) when constructing longitudinal joints where lift thicknesses are between 1½ and 3 inches, except for S1 and Class 4 mixes. Method II Butt Joint (see figure 4.06-2) shall be used for lifts less than 1½ inches or greater than 3 inches, and S1 and Class 4 mixes. During placement of multiple lifts of bituminous concrete, the longitudinal joint shall be constructed in such a manner that it is located at least 6 inches from the joint in the lift immediately below. The joint in the final lift shall be at the centerline or at lane lines. Each longitudinal joint shall maintain a consistent offset from the centerline of the roadway along its entire length.

Method I - Notched Wedge Joint:

Figure 4.06-1



A notched wedge joint shall be constructed, as shown in the figure using a device that is capable of adjusting the top and bottom vertical notches independently and is attached to the paver screed.
The taper portion of the joint must be placed over the longitudinal joint in the lift immediately below. The top vertical notch must be located at the centerline or lane line in the final lift. The requirement for paving full width “curb to curb” as described in Method II may be waived if addressed in the QC plan and approved by the Engineer.

The taper portion of the wedge joint shall be compacted and not be exposed to traffic for more than 5 calendar days.

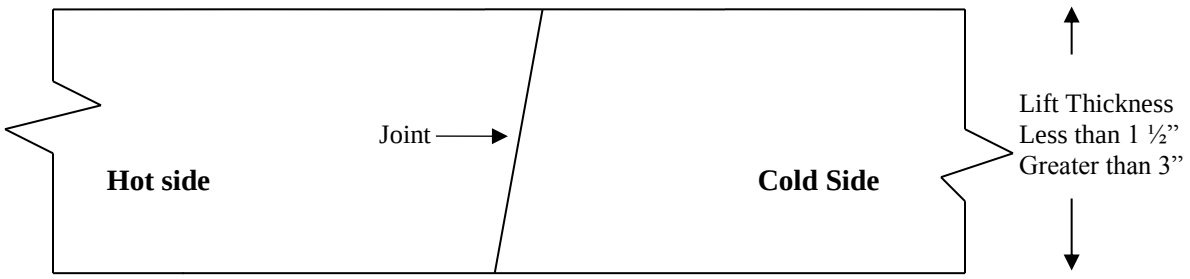
The pavement surface under the wedge joint must have an application of tack coat material. Prior to placing the completing pass (hot side), an application of tack coat must be applied to the exposed surface of the tapered section; regardless of time elapsed between paver passes. The in-place time allowance described in Sub article 4.06.03-7 does not apply to joint construction.

Any exposed wedge joint must be located to allow for the free draining of water from the road surface.

The Engineer reserves the right to define the paving limits when using a wedge joint that will be exposed to traffic.

Method II - Butt Joint:

Figure 4.06-2

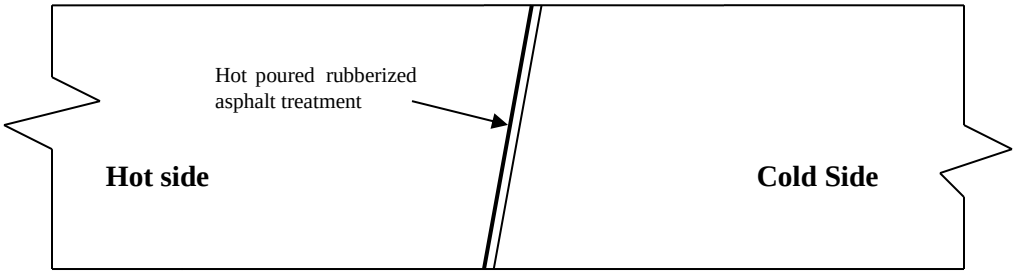


When adjoining passes are placed, the Contractor shall utilize equipment that creates a near vertical edge (refer to figure). The completing pass (hot side) shall have sufficient mixture so that the compacted thickness is not less than the previous pass (cold side). The end gate on the paver should be set so there is an overlap onto the cold side of the joint.

The Contractor shall not allow any butt joint to be incomplete at the end of a work shift unless otherwise allowed by the Engineer. When using this method, the Contractor is not allowed to leave a vertical edge exposed at the end of a work shift and must complete paving of the roadway full width “curb to curb.”

Method III- Butt Joint with Hot Poured Rubberized Asphalt Treatment: When required by the contract or allowed by the Engineer, Method III (see figure 4.06-3) may be used.

Figure 4.06-3



All of the requirements of Method II must be met with Method III. In addition, the longitudinal vertical edge must be treated with a joint seal material meeting the requirements of Section M.04 prior to placing a completing pass. The joint seal material shall be applied in accordance with the manufacturer's recommendation so as to provide a uniform coverage and avoid excess bleeding onto the newly placed pavement.

9. Contractor Quality Control (QC) Requirements for Placement:
The Contractor shall be responsible for maintaining adequate quality control procedures throughout the placement operations. Therefore, the Contractor must ensure that the materials, mixture and work provided by Subcontractors, Suppliers and Producers also meet contract specification requirements.

Quality Control Plan: Prior to placement the Contractor shall submit a QCP to the Engineer for approval. The QCP shall be submitted at the pre-construction meeting or a minimum 30 days prior to any production or paving. The QCP shall be in the format provided by the Engineer (http://www.ct.gov/dot/lib/dot/documents/dconstruction/pat/2012_qcp_outline_hma_placement_112012.pdf). Work covered by the QCP shall not commence until the Engineer's comments have been incorporated into the QCP and approved. The QCP shall detail every aspect of the placement process and if required, include a separate section on Extended Season paving as described in Section 4. "Seasonal Requirements". Information provided shall include the organization and procedures which the Contractor shall use to control all project site activity. The QCP must address the actions, inspection, or sampling and testing necessary to keep the production and placement operations in control, to determine when an operation has gone out of control and to respond to correct the situation in a timely fashion. The QCP shall also include details on when and who will communicate with personnel at the bituminous concrete plant to determine when immediate changes to the production or placement processes are needed, and to implement the required changes.

In addition the QCP shall also include the name and qualifications of a Quality Control Manager (QCM). The QCM shall be responsible for the administration of the QCP, and any modifications that may become necessary. The QCM shall have the ability to direct all Contractor personnel on the project during paving operations. All Contractor sampling, inspection and test reports shall be reviewed and signed by the QCM prior to submittal to the Engineer.

Approval of the QCP will be based on the inclusion of all of the required information. Approval of the QCP does not relieve the Contractor of its responsibility to comply with the project specifications. The Contractor may modify the QCP as work progresses and must document the changes in writing prior to commencing the next paving operation. These changes include but are not limited to changes in quality control procedures or personnel. Placement may be suspended by the Engineer until the revisions to the QCP have been put into effect.

The Quality Control Plan shall also include the name and qualifications of any outside testing laboratory performing any QC functions on behalf of the Contractor.

Quality Control Inspection, Sampling and Testing: The Contractor shall perform all quality control sampling and testing, provide inspection, and exercise management control to ensure that bituminous concrete production and placement conforms to the requirements as outlined in its QCP during all phases of the work.

a) Control Charts: The Contractor shall develop and maintain density control charts and shall submit them to the Engineer. The control charts shall include the project number, test numbers, test parameter, applicable upper and lower specification limits, and test data. The control charts shall be used as part of the quality control system to document the placement process. The control chart(s) shall be updated each day of production, and e a copy shall be submitted prior to the next day's production.

b) Records of Inspection and Testing: For each day of placement, the Contractor shall document all test results and inspections on forms approved by the Engineer. The document shall be certified by the Quality Control Manager or his representative that the information in the document is accurate, and that all work complies with the requirements of the contract.

The Contractor shall submit complete and accurate density sampling, testing and inspection documents to the Engineer within 48 hours. The documents shall be submitted in a manner acceptable to the Engineer.

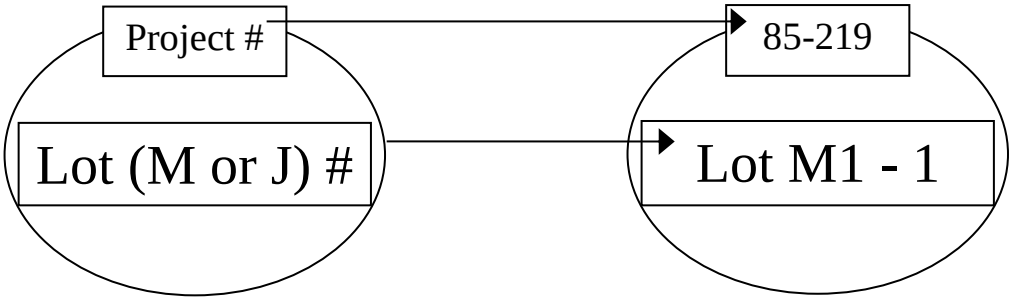
The Contractor may obtain one (1) mat core and one (1) joint core per day for process control, provided this process is detailed in the QCP. The results of these process control cores shall not be used to dispute the Department determinations from the acceptance cores. The Contractor shall submit the location of each process control core to the Engineer for approval prior to taking the core. Additional cores may be obtained to correlate a density gauge used by the contractor for quality control as approved by the Engineer. The core holes shall be filled to the same requirements described in Sub article 4.06.03-10.

10. **Density Testing of Bituminous Concrete Utilizing Core Samples:** This procedure describes the frequency and the method the Contractor shall use to obtain pavement cores for acceptance from the project. Coring shall be performed on each lift specified to a thickness of one and one-half (1 ½) inches or more. Each lift including the longitudinal joints shall be compacted to the degree specified in Tables 4.06-9 and 4.06-10. The density of each core shall be determined using the production lot's average maximum theoretical gravity established from the plant production testing. Bituminous concrete Class 4 and HMA S1 are excluded from the longitudinal joint density requirements.

The Contractor shall extract cores (4 or 6 inch diameter for S0.25, S0.375 and S0.5 mixes, 6 inch diameter for S1.0 mixtures -wet sawed) from sampling locations determined by the Engineer. The Engineer must witness the extraction and labeling of cores, as well as the filling of the core holes. The cores shall be labeled by the Contractor with the project number, lot number, and sub-lot number on the top surface of the core. When labeling the core lot number, include whether the core is from a mat lot or joint lot by using an "M" for a mat core and "J" for a joint core. For example, a core from the first sub-lot of the first mat lot shall be labeled with "Lot M1 – 1". The first number refers to the lot and the second number refers to the sub-lot. Refer to

Figure 4.06-4. The side of the cores shall be labeled with the core lot number and date placed. The project inspector shall fill out a MAT-109 containing the same information to accompany the cores. The Contractor shall deliver the cores and MAT-109 to the Department's Central Testing Lab in a safe manner to ensure no damage occurs to the cores. The Contractor shall use a container approved by the Engineer. In general the container shall consist of an attached lid container made out of plastic capable of being locked shut and tamper proof. The Contractor shall use foam, bubble wrap, or another suitable material to prevent the cores from being damaged during transportation. Once the cores and MAT-109 are in the container the Engineer will secure the lid using a security seal. The security seal's identification number must be documented on the MAT-109. The Central Lab will break the security seal and take possession of the cores upon receipt.

Figure 4.06-4



Frequency of sampling is in accordance with the following tables:

TABLE 4.06-4 - TESTING REQUIREMENT FOR BRIDGE DENSITY LOT

Length of Each Structure (Feet)	MAT – No. of Cores	JOINT - No. of cores
≤ 500'	See Table 4.06-5(A or B)	See Table 4.06-5(A or B)
501' – 1500'	3	3
1501' – 2500'	4	4
2501' and greater	5	5

All material placed on structures less than or equal to 500 feet in length shall be included as part of a standard lot as follows:

TABLE 4.06-5A – TESTING REQUIREMENT FOR DENSITY LOTS ≥ 500 TONS

Lot Type	No. of Mat Cores		No. of Joint Cores		Target Lot Size (Tons)
Lot Without Bridge(1)	4		4		2000
Lot With Bridge(s)(1)(2)	4 plus	1 per structure (≤ 300')	4 plus	1 per structure (≤ 300')	2000
		2 per structure (301' – 500')		2 per structure (301' – 500')	

TABLE 4.06-5B – TESTING REQUIREMENT FOR DENSITY LOTS < 500 TONS

Lot Type	No. of Mat Cores	No. of Joint Cores	Lot Size (Tons)
Lot Without Bridge(1)	3	3	1 per lift
Lot With Bridge(s)(1)(2)	3	3	1 per lift

Note (1): The number of "Required Paver Passes for Full Width" shall be used to determine the sub-lot sizes within the lot. The number of paver passes for full width is determined by the contractor.

Note (2): If a non-bridge mat or joint core location randomly falls on a structure, the core is to be obtained on the structure in addition to the core(s) required on the structure.

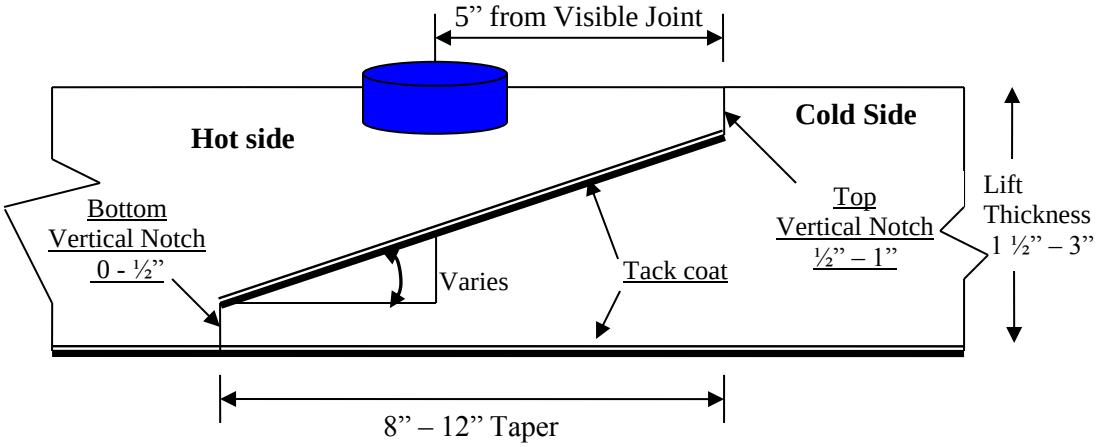
A density lot will be complete when the full designed paving width of the established lot length has been completed and shall include all longitudinal joints that exist between the curb lines regardless of date(s) paved. Quantity of material placed on structures less than or equal to 500 feet long is inclusive of the standard lot. Prior to paving, the total length of the project to be paved shall be split up into lots that contain approximately 2000 tons each. Areas such as highway ramps may be combined to create one lot. In general, combined areas should be set up to target a 2000 ton lot size. One adjustment will apply for each lot. The tons shall be determined using the yield calculation in Article 4.06.04. The last lot shall be the difference between the total payable tons for the project and the sum of the previous lots.

After the compaction process has been completed, the material shall be allowed to cool sufficiently to allow the cutting and removal of the core without damage. The Contractor shall core to a depth that allows extraction so that the uppermost layer being tested for density will not be affected.

A mat core shall not be taken any closer than one foot from the edge of a paver pass. If a random number locates a core less than one foot from any edge, locate the core so that the sample is one foot from the edge.

Joint cores must be taken so that the center of the core is 5 inches from the visible joint on the hot mat side. Refer to figure 4.06-5.

Figure 4.06-5



Cores may be obtained daily or weekly. All cores must be cut within 5 calendar days of placement. Any core that is damaged or obviously defective while being obtained will be replaced with a new core from a location within 2 feet measured in a longitudinal direction.

Core holes shall be filled immediately upon core extraction. Prior to being filled, the hole shall be prepared by removing any free water and applying tack coat using a brush or other means to uniformly cover the cut surface. The core hole shall be filled with a mixture containing the same nominal maximum aggregate size and compacted with a hand compactor or other mechanical means to the maximum compaction possible. The bituminous concrete mixture shall be compacted to ⅛ inch above the finished pavement prior to opening the roadway to traffic.

11. Acceptance Inspection, Sampling and Testing: Inspection, sampling, and testing to be used by the Engineer shall be performed at the minimum frequency specified in Section M.04 and stated herein.

Sampling for acceptance shall be established using ASTM D 3665, or a statistically based procedure of random sampling approved by the Engineer.

Plant Material Acceptance: The Contractor shall provide the required acceptance sampling, testing and inspection during all phases of the work in accordance with Section M.04. The Department will perform verification testing on the Contractor’s acceptance test results. Should binder content or air void results exceed the specified tolerances in the Department’s current QA Program for Materials, Acceptance and Assurance Testing Policies and Procedures, the Department will investigate to determine an assignable cause. Contractor’s test results for a subject lot or sub lot may be replaced with verification’s result for the purpose of assessing adjustments. The verification procedure is included in the Department’s current QA Program for Materials.

Density Acceptance: The Engineer will perform all acceptance testing on the cores in accordance with AASHTO T 331(M).

12. Density Dispute Resolution Process: The Contractor and Engineer will work in partnership to avoid potential conflicts and to resolve any differences that may arise during quality control or acceptance testing for density. Both parties will review their sampling and testing procedures and results and share their findings. If the Contractor disputes the Engineer's test results, the Contractor must submit in writing a request to initiate the Dispute Resolution Process within 10 calendar days of the notification of the test results. No request for dispute resolution will be allowed unless the Contractor provides quality control results within the timeframe described in Sub article 4.06.03-9 supporting its position. Should the dispute not be resolved through evaluation of existing testing data or procedures, the Engineer may authorize the Contractor to obtain a new set of core samples per disputed lot. The core samples must be extracted no later than 30 calendar days from the date of Engineer's authorization. The number and type (mat, joint, or structure) of the cores taken for dispute resolution must reflect the number and type of the cores taken for acceptance. The location of each core shall be 36" from the original acceptance core location forward along a line parallel to the baseline that results in the same type (mat, joint, or structure) of core. All such core samples shall be extracted and filled using the procedure outlined in Article 4.06.03. The results from the dispute resolution cores shall be added to the results from the acceptance cores and averaged for determining the final in-place density value.

13. Corrective Work Procedures: Any portion of the completed pavement that does not meet the requirements of the specification shall be corrected at the expense of the Contractor. Any corrective courses placed as the final wearing surface shall not be less than 1½ inches in thickness after compaction.

If pavement placed by the Contractor does not meet the specifications, and the Engineer requires its replacement or correction, the Contractor shall:

a) Propose a corrective procedure to the Engineer for review and approval prior to any corrective work commencing. The proposal shall include:
   - Limits of pavement to be replaced or corrected, indicating stationing or other landmarks that are readily distinguishable.
   - Proposed work schedule.
   - Construction method and sequence of operations.
   - Methods of maintenance and protection of traffic.
   - Material sources.
   - Names and telephone numbers of supervising personnel.

b) Perform all corrective work in accordance with the Contract and the approved corrective procedure.

14. Protection of the Work: The Contractor shall protect all sections of the newly finished pavement from damage that may occur as a result of the Contractor's operations for the duration of the Project. Prior to the Engineer's authorization to open the pavement to traffic, the Contractor is responsible to protect the pavement from damage.

15. Cut Bituminous Concrete Pavement: Work under this item shall consist of making a straight-line cut in the bituminous concrete pavement to the lines delineated on the plans or as directed by the Engineer. The cut shall provide a straight, clean, vertical face with no cracking, tearing or breakage along the cut edge.

4.06.04—Method of Measurement:

1. Bituminous Concrete Class ( ) or HMA S* or PMA S*: The quantity of bituminous concrete measured for payment will be determined by the documented net weight in tons accepted by the Engineer in accordance with this specification and Section M.04.

2. Adjustments: Adjustments may be applied to bituminous concrete quantities and will be measured for payment using the following formulas:

Yield Factor for Adjustment Calculation = 0.0575 Tons/SY/inch

Actual Area = [(Measured Length (ft)) x (Avg. of width measurements (ft))]

Actual Thickness (t) = Total tons delivered / [Actual Area (SY) x 0.0575 Tons/SY/inch]

a) Area: If the average width exceeds the allowable tolerance, an adjustment will be made using the following formula. The tolerance for width is equal to the specified thickness (in.) of the lift being placed.

Tons Adjusted for Area (T_A) = [(L x W_{adj})/9] x (t) x 0.0575 Tons/SY/inch = (-) Tons

Where: L = Length (ft)
(t) = Actual thickness (inches)
W_{adj} = (Designed width (ft) + tolerance /12) - Measured Width)

b) Thickness: If the actual thickness is less than the allowable tolerance, the Contractor shall submit a repair procedure to the Engineer for approval. If the actual thickness exceeds the allowable tolerance, an adjustment will be made using the following formula:

Tons Adjusted for Thickness (T_T) = A x t_{adj} x 0.0575 = (-) Tons

Where: A = Area = {[L x (Designed width + tolerance (lift thickness)/12)] / 9}
t_{adj} = Adjusted thickness = [(Dt + tolerance) - Actual thickness]
Dt = Designed thickness (inches)

c) Weight: If the quantity of bituminous concrete representing the mixture delivered to the project is in excess of the allowable gross vehicle weight (GVW) for each vehicle, an adjustment will be made using the following formula:

Tons Adjusted for Weight (T_W) = GVW – DGW= (-) Tons

Where: DGW = Delivered gross weight as shown on the delivery ticket or measured on a certified scale.

d) Mixture Adjustment: If the quantity of bituminous concrete representing the produced mixture exceeds one or more of the production tolerances for Marshall (Table 4.06-6) or Superpave mix designs (Table 4.06-7 and 4.06-8) , an adjustment will be made using the following formulas. The Department's Division of Material Testing will calculate the daily adjustment values for T_{MD} and T_{SD}.

(1) *Marshall Design*- The tolerances shown in Table 4.06-6 for gradation and binder content will be used to determine whether a mixture adjustment will apply. If the mixture does not meet the requirements of Section M.04, an adjustment will be computed using the following formula:

Tons Adjusted for Marshall Design (T_{MD}) = M x 0.10

Where: M= Tons of bituminous concrete mixture exceeding the tolerances in Table 4.06-5.

TABLE 4.06-6
TOLERANCES FOR CONSECUTIVE TESTS (MARSHALL)

Classes	Criteria	% Tolerances (+/-)
-	Binder	0.4
1, 2, 4, 5, 5A & 5B	#200	2.0
1, 2, 4	#50	4
1, 2, 5, 5A & 5B	#30	5
1, 2, 4, 5, 5A & 5B	#8	6
1, 2, 4, 5, 5A & 5B	#4	7
1, 2, 4, 5, 5A & 5B	⅜ & ½ inch	8

(2) *Superpave Design*- The adjustment values in Table 4.06-7 and 4.06-8 shall be calculated for each sub lot based on the Air Void and Liquid Binder Content test results for that sub lot. The total adjustment for each day's production (lot) will be computed using tables and the following formulas:

Tons Adjusted for Superpave Design (T_{SD}) = [($AdjAV_t$ + $AdjPB_t$) / 100] X Tons

Percent Adjustment for Air Voids = $AdjAV_t$ = [$AdjAV_1$ + $AdjAV_2$ + $AdjAV_i$ + … + $AdjAV_n$)] /n

Where: $AdjAV_t$ = Total percent air void adjustment value for the lot
$AdjAV_i$ = Adjustment value from Table 4.06-7 resulting from each sub lot or the average of the adjustment values resulting from multiple tests within a sub lot, as approved by the Engineer.
n = number of sub lots based on Table M.04.03-1

TABLE 4.06-7
ADJUSTMENT VALUES FOR AIR VOIDS (SUPERPAVE)

Adjustment Value ($AdjAV_i$) (%)	**S0.25, S0.375, S0.5, S1 Air Voids (AV)**
+2.5	3.8 - 4.2
+3.125*(AV-3)	3.0 - 3.7
-3.125*(AV-5)	4.3 – 5.0
20*(AV-3)	2.3 – 2.9
-20*(AV-5)	5.1 – 5.7
-20.0	≤ 2.2 or ≥ 5.8

Percent Adjustment for Liquid Binder = $AdjPB_t$ = [($AdjPB_1$ + $AdjPB_2$ + $AdjPB_i$ + … + $AdjPB_n$)] / n

Where: $AdjPB_t$= Total percent liquid binder adjustment value for the lot
$AdjPB_i$ = Adjustment value from Table 4.06-7 resulting from each sub lot
n = number of binder tests in a production lot

TABLE 4.06-8

Adjustment Value ($AdjAV_i$) (%)	**S0.25, S0.375, S0.5, S1 Pb (refer to Table M.04.03-5)**
0.0	Equal to or above the min. liquid content
- 10.0	Below the min. liquid content

e) Density Adjustment: The quantity of bituminous concrete measured for payment for a specified lift of pavement 1½ inches or greater may be adjusted for density. Separate density adjustments will be made for each lot and will not be combined to establish one density adjustment. If either the Mat or Joint adjustment value is "remove and replace", the density lot shall be removed and replaced (curb to curb).

Tons Adjusted for Density (T_D) = [{(PA_M x .50) + (PA_J x .50)} / 100] X Density Lot Tons

Where: T_D = Total tons adjusted for density for each lot
PA_M = Mat density percent adjustment from Table 4.06-9
PA_J = Joint density percent adjustment from Table 4.06-10

TABLE 4.06-9
ADJUSTMENT VALUES FOR PAVEMENT MAT DENSITY

Average Core Result Percent Mat Density	Percent Adjustment (Bridge and Non-Bridge) (1,2)
97.1 - 100	-1.667*(ACRPD-98.5)
94.5 – 97.0	+2.5
93.5 – 94.4	+2.5*(ACRPD-93.5)
92.0 – 93.4	0
90.0 – 91.9	-5*(92-ACRPD)
88.0 – 89.9	-10*(91-ACRPD)
87.0 – 87.9	-30
86.9 or less	Remove and Replace (curb to curb)

TABLE 4.06-10
ADJUSTMENT VALUES FOR PAVEMENT JOINT DENSITY

Average Core Result Percent Joint Density	Percent Adjustment (Bridge and Non-Bridge) (1,2)
97.1 – 100	-1.667*(ACRPD-98.5)
93.5 – 97.0	+2.5
92.0 – 93.4	+1.667*(ACRPD-92)
91.0 – 91.9	0
89.0 – 90.9	-7.5*(91-ACRPD)
88.0 – 88.9	-15*(90-ACRPD)
87.0 – 87.9	-30
86.9 or less	Remove and Replace (curb to curb)

(1) ACRPD = Average Core Result Percent Density
(2) All Percent Adjustments to be rounded to the second decimal place. For example, 1.667 is to be rounded to 1.67.

3. Transitions for Roadway Surface: The installation of permanent transitions shall be measured under the appropriate item used in the formation of the transition.

The quantity of material used for the installation of temporary transitions shall be measured for payment under the appropriate item used in the formation of the transition. The installation and removal of a bond breaker, and the removal and disposal of any temporary transition formed by milling or with bituminous concrete pavement is not measured for payment.

4. Cut Bituminous Concrete Pavement: The quantity of bituminous concrete pavement cut will be measured in accordance with Article 2.02.04.

5. Material for Tack Coat: The quantity of tack coat will be measured for payment by the number of gallons furnished and applied on the Project and approved by the Engineer. No tack coat material shall be included that is placed in excess of the tolerance described in Article 4.06.03.

Method of Measurement:

a. Container Method- Material furnished in a container will be measured to the nearest ½ gallon. The volume will be determined by either measuring the volume in the original container by a method approved by the Engineer or using a separate graduated container capable of measuring the volume to the nearest ½ gallon. The container in which the material is furnished must include the description of material, including lot number or batch number and manufacturer or product source.

b. Truck Method- The Engineer will establish a weight per gallon of the bituminous material based on the specific gravity at 60ºF for the material furnished. The number of gallons furnished will be determined by weighing the material on scales furnished by and at the expense of the Contractor.

6. Material Transfer Vehicle (MTV) **- The furnishing and use of a MTV will be measured separately for payment based on the actual number of surface course tons delivered to a paver using the MTV.**

4.06.05—Basis of Payment:

1. Bituminous Concrete Class ( ), HMA S* or PMA S*: The furnishing and placing of bituminous concrete will be paid for at the Contract unit price per ton for "Bituminous Concrete, Class ( )" or “HMA S*” or “PMA S*”.

- All costs associated with providing illumination of the work area are included in the general cost of the work.
- All costs associated with constructing longitudinal joints are included in the general cost of the work.
- All costs associated with obtaining cores for core correlation and dispute resolution are included in the general cost of the work.

2. **Bituminous Concrete Adjustment Costs**: The adjustment will be calculated using the formulas shown below if all of the measured adjustments in Article 4.06.04 do not equal zero. A payment will be made for a positive adjustment. A deduction from monies due the Contractor will be made for a negative adjustment.

Production Lot: $[T_T + T_A + T_W + (T_{MD} \text{ or } T_{SD})] \times \text{Unit Price} = \text{Est. (P)}$

Density Lot: $T_D \times \text{Unit Price} = \text{Est. (D)}$

Where: Unit Price = Contract unit price per ton per type of mixture

T_* = Total tons of each adjustment calculated in Article 4.06.04

Est. ( ) = Pay Unit represented in dollars representing incentive or disincentive.

The estimated cost figure if included in the bid proposal or estimate is not to be altered in any manner by the bidder. If the bidder should alter the amount shown, the altered figure will be disregarded and the original cost figure will be used to determine the amount of the bid for the Contract.

3. Transitions for Roadway Surface: The installation of permanent transitions shall be paid under the appropriate item used in the formation of the transition. The quantity of material used for the installation of temporary transitions shall be paid under the appropriate pay item used in the formation of the transition. The installation and removal of a bond breaker, and the removal and disposal of any temporary transition formed by milling or with bituminous concrete pavement is included in the general cost of the work.

5. Material for tack coat will be paid for at the Contract unit price per gallon for "Material for Tack Coat".

6. The Material Transfer Vehicle (MTV) will be paid at the Contract unit price per ton for a "Material Transfer Vehicle".

Pay Item*	Pay Unit*
HMA S0.375*	ton
HMA S0.5*	ton
Bituminous Concrete Adjustment Cost	est.
Material for Tack Coat	gal.
Material Transfer Vehicle	ton

*For contracts administered by the State of Connecticut, Department of Administrative Services, the pay items and pay units are as shown in contract award price schedule.

NOTICE TO CONTRACTOR - SECTION M.04 - BITUMINOUS CONCRETE

Section M.04 is being deleted in its entirety and replaced with the following:

M.04.01—Bituminous Concrete Materials and Facilities
M.04.02—Mix Design and Job Mix Formula (JMF)
M.04.03—Production Requirements

M.04.01—Bituminous Concrete Materials and Facilities: Each source of material, and facility or plant used to produce and test bituminous concrete must be qualified on an annual basis by the Engineer. Test Procedures and Specifications referenced herein are in accordance with the latest AASHTO and ASTM Standard Test Procedures and Specifications. Such references when noted with an (M) have been modified by the Engineer and are detailed in Table M.04.03-6.

The Contractor shall submit to the Engineer all sources of coarse aggregate, fine aggregate, mineral filler, PG binder, and if applicable any additives such as but not limited to anti-strip, warm mix, and polymer modifiers. The Contractor shall submit a Material Safety Data Sheet (MSDS) for each grade of binder, and additive to be used on the Project. The Contractor shall not change any material sources without prior approval of the Engineer.

An adequate quantity of each size aggregate, mineral filler, bitumen, and additives, shall be maintained at the bituminous concrete plant site at all times while the plant is in operation to ensure that the plant can consistently produce bituminous concrete mixtures that meet the job mix formula (JMF) as specified in Article M.04.02. The quantity of such material shall be reviewed by the Engineer on an individual plant basis and is dependent upon the plant's daily production capacity. A total quantity of any material on site that amounts to less than one day's production capacity may be cause for the job mix formula to be rejected.

1. Coarse Aggregate:

a. Requirements: The coarse aggregate shall consist of clean, hard, tough, durable fragments of crushed stone or crushed gravel of uniform quality. Aggregates from multiple sources of supply must not be mixed or stored in the same stockpile.

b. Basis of Approval: The request for approval of the source of supply shall include a washed sieve analysis in accordance with AASHTO T 27. The Gsa, Gsb, and Pw_a shall be determined in accordance with AASHTO T 85. The coarse aggregate must not contain more than 1% crusher dust, sand, soft disintegrated pieces, mud, dirt, organic and other injurious materials. When tested for abrasion using AASHTO T 96, the aggregate loss must not exceed 40%. When tested for soundness using AASHTO T 104 with a magnesium sulfate solution, the coarse aggregate must not have a loss exceeding 10% at the end of 5 cycles.

For all bituminous mixtures, materials shall also meet the coarse aggregate angularity criteria as specified in Tables M.04.02-2 thru M.04.02-4 for blended aggregates retained on the #4 sieve when tested according to ASTM D 5821. The amount of aggregate particles of the coarse aggregate blend retained on the #4 sieve that are flat or elongated

shall be determined in accordance with ASTM D 4791 and shall not exceed 10% by weight when tested to a 3:1 ratio, as shown in Tables M.04.02-2 thru M.04.02-4.

2. Fine Aggregate:

Requirements: The fine aggregate from each source quarry/pit deposit shall consist of clean, hard, tough, rough-surfaced and angular grains of natural sand; manufactured sand prepared from washed stone screenings; stone screenings, slag or gravel; or combinations thereof, after mechanical screening or manufactured by a process approved by the Engineer. The Contractor is prohibited from mixing two or more sources of fine aggregate on the ground for the purpose of feeding into a plant.

a. All fine aggregate shall meet the listed criteria shown in items #1 thru #7 of Table M.04.01-1. Table M.04.01-1 indicates the quality tests and criteria required for all fine aggregate sources. Individually approved sources of supply shall not be mixed or stored in the same stockpile. The fine aggregates must be free from injurious amounts of clay, loam, and other deleterious materials.

For Superpave mixtures, in addition to the above requirements, the fine aggregate angularity shall be determined by testing the materials passing the #8 sieve in accordance with AASHTO T 304, Method A. Qualification shall be based on the criteria listed in Tables M.04.02-2 thru M.04.02-4. The fine aggregate shall also be tested for clay content as a percentage contained in materials finer than the #8 sieve in accordance with AASHTO T 176.

Table M.04.01-1: Fine Aggregate Criteria by Pit/Quarry Source

Item	Title	AASHTO Protocol(s)	Criteria
1	Grading	T 27 & T 11	100% Passing 3/8 inch 95% Passing the #4 min.
2	Absorption	T 84	3% maximum
3	Plasticity limits	T 90	0 or not detectable
4	L.A. Wear	T 96	50% maximum(fine agg. particle size # 8 and above)
5	Soundness by Magnesium Sulfate	T 104	20% maximum @ 5 cycles
6	Clay Lumps and Friable Particles	T 112	3% maximum
7	Deleterious Material	As determined by the Engineer	Organic or inorganic calcite, hematite, shale, clay or clay lumps, friable materials, coal-lignite, shells, loam, mica, clinkers, or organic matter (wood, etc). -Shall not contain more than 3% by mass of any individual listed constituent and not more than 5% by mass in total of all listed constituents.
8	Petrographic Analysis	ASTM C 295	Terms defined in Section M.04.01-2c.

b. Basis of Approval: A Quality Control Plan for Fine Aggregate (QCPFA) provided by the Contractor shall be submitted for review and approval for each new source documenting how conformance to Items 1 through 7 as shown in Table M.04.01-1 is monitored. The

QCPFA must be resubmitted any time the process, location or manner of how the fine aggregate (FA) is manufactured changes, or as requested by the Engineer. The QCPFA must include the locations and manufacturing processing methods. The QCPFA for any source may be suspended by the Engineer due to the production of inconsistent mixtures.

The Contractor shall submit all test results to the Engineer for review. The Contractor shall also include a washed sieve analysis in accordance with AASHTO T 27/T 11. Any fine aggregate component or final combined product shall have 100% passing the 3/8 inch sieve and a minimum of 95% passing the # 4. The Gsa, Gsb, and Pw_a shall be determined in accordance with AASHTO T 84.

The Contractor will be notified by the Engineer if any qualified source of supply fails any portion of Table M.04.01-1. One retest will be allowed for the Contractor to make corrections and/or changes to the process. If, upon retest, the material does not meet the requirements of items 1-7, additional testing will be required in accordance with item 8.

c. The Contractor may provide a Petrographic analysis of the material performed by a third party acceptable to the Engineer at its' own expense. The Contractor shall submit the results of the analysis with recommended changes to the manufacturing process to the Engineer. The Contractor shall submit fine aggregate samples for testing by the Engineer after the recommended changes have been made.

   The Contractor may request the use of such fine aggregate on select project(s) for certain applications of bituminous concrete pavement. Such material will be monitored for a period no less than 48 months, at no cost to the State. Terms of any evaluation and suitable application will be determined by the Engineer.

3. Mineral Filler:

a. Requirements: Mineral filler shall consist of finely divided mineral matter such as rock dust, including limestone dust, slag dust, hydrated lime, hydraulic cement, or other accepted mineral matter. At the time of use it shall be freely flowing and devoid of agglomerations. Mineral filler shall be introduced and controlled at all times during production in a manner acceptable to the Engineer.

b. Basis of Approval: The request for approval of the source of supply shall include the location, manufacturing process, handling and storage methods for the material. Mineral filler shall conform to the requirements of AASHTO M-17

4. Liquid Bituminous Materials:

a. General:

   i Liquid PG binders shall be uniformly mixed and blended and be free of contaminants such as fuel oils and other solvents. Binders shall be properly heated and stored to prevent damage or separation.

ii. The blending at mixing plants of PG binder from different suppliers is strictly prohibited. Contractors who blend PG binders will be classified as a supplier and will be required to certify the binder in accordance with AASHTO R-26(M). The binder shall meet the requirements of AASHTO M-320(M) and AASHTO R-29(M). The Contractor shall submit a Certified Test Report and bill of lading representing each delivery in accordance with AASHTO R-26(M). The Certified Test Report must also indicate the binder specific gravity at 77ºF; rotational viscosity at 275ºF and 329ºF and the mixing and compaction viscosity-temperature chart for each shipment.

iii. The Contractor shall submit the name(s) of personnel responsible for receipt, inspection, and record keeping of PG binder materials. Contractor plant personnel shall document specific storage tank(s) where binder will be transferred and stored until used, and provide binder samples to the Engineer upon request. The person(s) shall assure that each shipment (tanker truck) is accompanied by a statement certifying that the transport vehicle was inspected before loading and was found acceptable for the material shipped and that the binder will be free of contamination from any residual material, along with two (2) copies of the bill of lading.

iv. Basis of Approval: The request for approval of the source of supply shall list the location where the material will be manufactured, and the handling and storage methods, along with necessary certification in accordance with AASHTO R-26(M). Only suppliers/refineries that have an approved "Quality Control Plan for Performance Graded Binders" formatted in accordance with AASHTO R-26(M) will be allowed to supply PG binders to Department projects.

b. <u>Neat Performance Grade (PG) Binder</u>:

i. PG binder shall be classified by the supplier as a "Neat" binder for each lot and be so labeled on each bill of lading. Neat PG binders shall be free from modification with: fillers, extenders, reinforcing agents, adhesion promoters, thermoplastic polymers, acid modification and other additives, and shall indicate such information on each bill of lading and certified test report.

ii. The asphalt binder shall be Performance Grade PG 64-22.

c. <u>Modified Performance Grade (PG) Binder</u>

Unless otherwise noted, the asphalt binder shall be Performance Grade PG 76-22 asphalt modified with a Styrene-Butadiene-Styrene (SBS) polymer. The polymer modifier shall be added at either the refinery or terminal and delivered to the bituminous concrete production facility as homogenous blend. The stability of the modified binder shall be verified in accordance with ASTM D7173 using the Dynamic Shear Rheometer (DSR). The DSR $G^*/\sin(\delta)$ results from the top and bottom sections of the ASTM D7173 test shall not differ by more than 10%. The results of ASTM D7173 shall be included on the Certified Test Report. The binder shall meet the requirements of AASHTO M-320(M) and AASHTO R-29(M).

d. Warm Mix Additive or Technology:

i. The warm mix additive or technology must be listed on the NEAUPG Qualified Warm Mix Asphalt (WMA) Technologies List at the time of bid, which may be accessed online at http://www.neaupg.uconn.edu/wma_info.html.

ii. The warm mix additive shall be blended with the asphalt binder in accordance with the manufacturer's recommendations.

iii. The blended binder shall meet the requirements of AASHTO M-320(M) and AASHTO R-29(M) for the specified binder grade. The Contractor shall submit a Certified Test Report showing the results of the testing demonstrating the binder grade. In addition, it must include the grade of the virgin binder, the brand name of the warm mix additive, the manufacturer's suggested rate for the WMA additive, the water injection rate (when applicable) and the WMA Technology manufacturer's recommended mixing and compaction temperature ranges.

e. Cut-backs (medium cure type);

i. Requirements: The liquid petroleum materials shall be produced by fluxing an asphalt base with appropriate petroleum distillates to produce the grade specified.

ii. Basis of Approval: The request for approval of the source of supply shall be submitted at least seven days prior to its use listing the location where the materials will be produced, and manufacturing, processing, handling and storage methods. The Contractor shall submit a Certified Test Report in accordance with Section 1.06 and a Material Safety Data Sheet (MSDS) for the grade to be used on the Project. The liquid asphalt shall be MC-250 conforming to AASHTO M-82.

f. Emulsions

i. Requirements: The emulsified asphalt shall be homogeneous and not be used if exposed to freezing temperatures.

ii. Basis of Approval**:** The request for approval of the source of supply must include the location where the materials will be produced, and manufacturing, processing, handling and storage methods.

1. Emulsified asphalts shall conform to the requirements of AASHTO M-140. Materials used for tack coat shall not be diluted and meet grade RS-1. When ambient temperatures are 80˚F and rising, grade SS-1 or SS-lh may be substituted if accepted by the Engineer. Each shipment shall be accompanied with a Certified Test Report listing Saybolt viscosity, residue by evaporation, penetration of residue, and weight per gallon.

2. Cationic emulsified asphalt shall conform to the requirements of AASHTO M-208(M). Materials used for tack coat shall not be diluted and meet grade CRS-1. The settlement and demulsibility test will not be performed unless deemed

necessary by the Engineer. When ambient temperatures are 80˚F and rising, grade CSS-1 or CSS-lh may be substituted if accepted by the Engineer. Each shipment shall be accompanied with a Certified Test Report listing Saybolt viscosity, residue by evaporation, penetration of residue, and weight per gallon.

5. Reclaimed Asphalt Pavement (RAP):

a. Requirements: RAP shall consist of asphalt pavement constructed with asphalt and aggregate reclaimed by cold milling or other removal techniques approved by the Engineer. For bituminous concrete mixtures containing RAP, the Contractor shall submit a JMF in accordance with Article M.04.02 to the Engineer for review.

b. Basis of Approval: The RAP material will be accepted on the basis of one of the following criteria:

i. When the source of all RAP material is from pavements previously constructed on Department projects, the Contractor shall provide a materials certificate listing the detailed locations and lengths of those pavements and that the RAP is only from those locations listed.

ii. When the RAP material source or quality is not known, the Contractor shall test the material and provide the following information along with a request for approval to the Engineer at least 30 calendar days prior to the start of the paving operation. The request shall include a material certificate stating that the RAP consists of aggregates that meet the specification requirements of sub articles M.04.01-1 through 3 and that the binder in the RAP is substantially free of solvents, tars and other contaminants. The Contractor is prohibited from using unapproved material on Department projects and shall take necessary action to prevent contamination of approved RAP stockpiles. Stockpiles of unapproved material shall remain separate from all other RAP materials at all times. The request for approval shall include the following:

1. A 50-pound sample of the RAP to be incorporated into the recycled mixture.
2. A 25-pound sample of the extracted aggregate from the RAP.
3. A statement that RAP material has been crushed to 100% passing the ½ inch sieve and remains free from contaminants such as joint compound, wood, plastic, and metals.

6. Crushed Recycled Container Glass (CRCG):

a. Requirements: The Contractor may propose to use clean and environmentally-acceptable CRCG in an amount not greater than 5% by weight of total aggregate.

b. Basis of Approval: The Contractor shall submit to the Engineer a request to use CRCG. The request shall state that the CRCG contains no more than 1% by weight of contaminants such as paper, plastic and metal and conform to the following gradation:

CRCG Grading Requirements	
Sieve Size	Percent Passing
3/8-inch	100
No. 4	35-100
No. 200	0.0-10.0

7. Joint Seal Material:

Requirements: Joint seal material shall be a hot-poured rubber compound intended for use in sealing joints and cracks in bituminous concrete pavements. Joint seal material must meet the requirements of AASHTO M-324 – Type 2.

8. Plant Requirements:

a. Mixing Plant and Machinery:

The mixing plant used in the preparation of the bituminous concrete shall comply with AASHTO M-156(M)/ASTM D 995 for a Batch Plant or a Drum Dryer Mixer Plant, and be approved by the Engineer.

b. Storage Silos:

For all mixes, the Contractor may use silos for short-term storage of Superpave mixtures with prior notification and approval of the Engineer. A silo must have heated cones and an unheated silo cylinder if it does not contain a separate internal heating system. Prior approval must be obtained for storage times greater than those indicated. When multiple silos are filled, the Contractor shall discharge one silo at a time. Simultaneous discharge of multiple silos is not permitted.

Type of silo cylinder	Maximum storage time for all classes (hr)	
	HMA	WMA/PMA
Open Surge	4	Mfg Recommendations
Unheated – Non-insulated	8	Mfg Recommendations
Unheated – Insulated	18	Mfg Recommendations
Heated – No inert gas	TBD by the Engineer	

c. Documentation System: The mixing plant documentation system shall include equipment for accurately proportioning the components of the mixture by weight and in the proper order, controlling the cycle sequence and timing the mixing operations. Recording equipment shall monitor the batching sequence of each component of the mixture and produce a printed record of these operations on each delivery ticket, as specified herein. Material feed controls shall be automatically or manually adjustable to provide proportions within the tolerances listed below for any batch size.

An asterisk (*) shall be automatically printed next to any individual batch weight(s) exceeding the tolerances in ASTM D 995 section 8.7.3. The entire batching and mixing interlock cut-off circuits shall interrupt and stop the automatic batching operations when an error exceeding the acceptable tolerance occurs in proportioning.

There must be provisions so that scales are not manually adjusted during the printing process. In addition, the system shall be interlocked to allow printing only when the scale has come to a complete rest. A unique printed character (m) shall automatically be printed on the truck and batch plant printout when the automatic batching sequence is interrupted or switched to auto-manual or full manual during proportioning. For each day's production, each project shall be provided a clear, legible copy of these recordings on each delivery ticket.

d. Aggregates: The Contractor shall ensure that aggregate stockpiles are managed to provide uniform gradation and particle shape, prevent segregation and cross contamination in a manner acceptable to the Engineer. For drum plants only, the Contractor shall determine the percent moisture content at a minimum, prior to production and half way through production.

e. Mixture: The dry and wet mix times shall be sufficient to provide proper coating (minimum 95% as determined by AASHTO T 195(M)) of all particles with bitumen and produce a uniform mixture.

   The Contractor shall make necessary adjustments to ensure all types of bituminous concrete mixtures contain no more than 0.5% moisture throughout when tested in accordance with AASHTO T 329.

f. RAP: The Contractor shall indicate the percent of RAP, the moisture content (as a minimum determined twice daily – prior to production and halfway through production), and the net dry weight of RAP added to the mixture on each truck ticket. For each day of production, the production shall conform to the job mix formula and RAP percentage and no change shall be made without the prior approval of the Engineer.

g. Asphalt Binder: The last day of every month, a binder log shall be submitted when the monthly production for the Department exceeds 5000 tons. Blending of PG binders from different suppliers or grades at the bituminous concrete production facility is strictly prohibited.

h. Warm mix additive: For mechanically foamed WMA, the maximum water injection rate shall not exceed 2.0% water by total weight of binder and the water injection rate shall be constantly monitored during production.

i. Field Laboratory: The Contractor shall furnish the Engineer an acceptable field laboratory at the production facility to test bituminous concrete mixtures during production. The field laboratory shall have a minimum of 300 square feet, have a potable water source and drainage in accordance with the CT Department of Public Health Drinking Water Division, be equipped with all necessary testing equipment as well as with a PC, printer, and telephone with a dedicated hard-wired phone line. In addition, the PC shall have a high speed internet connection with a minimum upstream of 384 Kbps and a functioning web browser with unrestricted access to https://ctmail.ct.gov. This equipment shall be maintained in clean and good working order at all times and be made available for use by the Engineer.

The laboratory shall be equipped with a suitable heating system capable of maintaining a minimum temperature of 65°F. It shall be clean and free of all materials and equipment not associated with the laboratory. Windows shall be installed to provide sufficient light and ventilation. During summer months adequate cooling or ventilation must be provided so the indoor air temperature shall not exceed the ambient outdoor temperature. Light fixtures and outlets shall be installed at convenient locations, and a telephone shall be within audible range of the testing area. The laboratory shall be equipped with an adequate workbench that has a suitable length, width, and sampling tables, and be approved by the Engineer.

The field laboratory testing apparatus, supplies, and safety equipment shall be capable of performing all tests in their entirety that are referenced in AASHTO R 35(M), *Standard Practice for Superpave Volumetric Design for Hot-Mix Asphalt (HMA)* and AASHTO M 323, *Standard Specification for Superpave Volumetric Mix Design*. In addition, the quantity of all equipment and supplies necessary to perform the tests must be sufficient to initiate and complete the number of tests identified in Table M.04.03-2 for the quantity of mixture produced at the facility on a daily basis. The Contractor shall ensure that the Laboratory is adequately supplied at all times during the course of the project with all necessary testing materials and equipment.

The Contractor shall maintain a list of laboratory equipment used in the acceptance testing processes including but not limited to, balances, scales, manometer/vacuum gauge, thermometers, gyratory compactor, clearly showing calibration and/or inspection dates, in accordance with AASHTO R-18.The Contractor shall notify the Engineer if any modifications are made to the equipment within the field laboratory. The Contractor shall take immediate action to replace, repair, and/or recalibrate any piece of equipment that is out of calibration, malfunctioning, or not in operation.

M.04.02—Mix Design and Job Mix Formula (JMF)

1. Marshall Method - Class 1, 2, 3, 4, 5, 5A, 5B and 12:

a. Requirements: When specified, the Marshall method shall be employed to develop a bituminous concrete mix design that includes a JMF consisting of target values for gradation and bitumen content for each class of bituminous concrete designated for the project in accordance with the latest Asphalt Institute's MS-2 manual. Each class of bituminous concrete must meet the requirements as shown in Table M.04.02-1.

b. Basis of Approval: The Contractor shall submit to the Engineer a request for approval of the JMF annually in accordance with one of the methods described herein. Prior to the start of any paving operations, the JMF and production percentage of bitumen must be accepted by the Engineer, and the Contractor must demonstrate the ability to meet the accepted JMF and production percentage of bitumen for each class of mixture. Additionally, the fraction of material retained between any two consecutive sieves shall not be less than 4%.

The Engineer will test each class of mixture for compliance with the submitted JMF and Table M.04.02-1. The maximum theoretical density (Gmm) will be determined by

AASHTO T 209(M). If the mixture does not meet the requirements, the JMF shall be adjusted within the ranges shown in Table M.04.02-1 until an acceptable mixture is produced. All equipment, tests and computations shall conform to the Marshall method in accordance with AASHTO T 245(M).

An accepted JMF from the previous operating season may be acceptable to the Engineer provided that there are no changes in the sources of supply for the coarse aggregate, fine aggregate, recycled material (if applicable) and the plant operation had been consistently producing acceptable mixture.

The Contractor shall not change sources of supply after a JMF has been accepted. Before a new source of supply for materials is used, a new JMF shall be submitted to the Engineer for approval.

c. Marshall Mixture (Virgin): For bituminous concrete mixtures that contain no recycled material, the limits prescribed in Table M.04.02-1 govern. The Contractor shall submit to the Engineer for approval, a JMF with the individual fractions of the aggregate expressed as percentages of the total weight of the mix and the source(s) of all materials. The JMF shall indicate two bitumen contents; the JMF target percentage and a production percentage (actual amount added to mix) of bitumen for each mix class by total weight. For surface course Class 1, a 0.45 power gradation chart shall also be submitted on which is plotted the percentage passing each sieve. The JMF shall also indicate the target temperature of completed mixture as it is dumped from the mixer and tested in accordance with Article M.04.03.

d. Marshall Mixtures with RAP: In addition to subarticles M.04.02 – 1a through c, RAP in bituminous concrete shall comply with requirements stated in Article M.04.01, and as stated herein. Upon approval of the Engineer, a maximum of 15% RAP may be used with no binder grade modification. RAP material shall not be used with any other recycling option.
The Contractor may increase the RAP percentage in 5% increments up to a maximum of 30% provided a new JMF is accepted by the Engineer. The following information shall be included in the JMF submittal:
   - Gradation and asphalt content of the RAP.
   - Percentage of RAP to be used.
   - Virgin aggregate source(s).
   - Total binder content based on total mixture weight.
   - Production pull percentage of added virgin binder based on total mixture weight.
   - Gradation of combined bituminous concrete mixture (including RAP).
   - Grade of virgin added, if greater than 15% of total mix weight.

e. Marshall Mixture with CRCG: In addition to subarticle M.04.02 – 1a through c, for bituminous concrete that contains CRCG, the Contractor shall submit a materials certificate to the Engineer stating that the mixture and its components comply with requirements stated in subarticle M.04.01 - (6). Additionally, 1% hydrated lime, or other accepted non-stripping agent, shall be added to all mixtures containing CRCG. CRCG material shall not be used with any other recycling option.

2. Cold Patch Method - Class 5, 5A, 5B:

a. Requirements: This mixture must be capable of being stockpiled and workable at all times. A non-stripping agent accepted by the Engineer shall be used in accordance with manufacturer's recommendations. The Contractor shall take necessary steps to ensure that this mixture uses aggregate containing no more than 1% moisture and is not exposed to any rain, snow, or standing water for a period of 6 hours after being mixed. This mixture shall be mixed and stockpiled at the point of production on a paved surface at a height not greater than 4 feet during the first 48 hours prior to its use.

   i. Class 5A mixture shall have 3/8 to ½ inch polypropylene fibers that have been approved by the Engineer added at a rate of 6 pounds per ton of mixture.

   ii. Class 5B mixture shall have ¼ inch polyester fibers that have been approved by the Engineer added at the rate of 2 1/2 pounds per ton of mixture.

   iii. Class 5 mixture shall not contain fibers.

b. Basis of Approval: The aggregates, fibers and binder (MC-250) shall meet the requirements as specified in sub articles M.04.01-1 through 4 and in Table M.04.02-1. The use of recycled material is not permitted with these classes of bituminous concrete. Mixtures not conforming to the binder content as shown in Table M.04.02-1 shall be subject to rejection. There is a two test minimum per day of production. Mixtures not conforming to the gradation as shown in Table M.04.02-1 shall be subject to payment adjustment as specified in Section 4.06.

TABLE M.04.02 – 1 MASTER RANGES FOR MARSHALL BITUMINOUS-CONCRETE MIXTURES

Notes: (a) 75 blow (Marshall Criteria). (b) 3-6% when used for a roadway wearing surface. (c) For divided highways with 4 or more lanes, a stability of 1500 lbs is required. (d) Contains an accepted non-stripping compound. (e) To help prevent stripping, the mixed material will be stockpiled on a paved surface and at a height not greater than 4 feet during the first 48 hours. (f) As determined by AASHTO T 245(M). (g) The percent passing the #200 sieve shall not exceed the percentage of bituminous asphalt binder determined by AASHTO T 164 or AASHTO T 308(M). (h) Mixture with 5% or more aggregate retained on ¾" sieve. (i) Mixtures finer than condition (h) above. (j) Class 5 mixture shall contain no fibers. Class 5A mixture shall have 3/8 to ½ inch polypropylene fibers that have been previously accepted by the Engineer added at a minimum rate of 6 pounds per ton of mixture. Class 5B mixture shall have ¼ inch polyester fibers that have been previously accepted by the Engineer added at the minimum rate of 2 1/2 pounds per ton of mixture

CLASS	1	2	3	4	12	5 (e)(j)	5A (e)(j)	5B (e)(j)	JMF % Tol. (±)
Grade of PG Binder content %	**PG 64-22 5.0 – 6.5**	**PG 64-22 5.0 – 8.0**	**PG 64-22 6.5 - 9.0**	**PG 64-22 4.0 - 6.0**	**PG 64-22 7.5 - 10.0**	**MC-250 (d) 6.0 - 7.5**	**MC-250 (d) 6.0 - 7.5**	**MC-250 (d) 6.0 - 7.5**	0.4
Sieve Size	**Percent Passing (%)**								
# 200	3.0 – 8.0 (g)	3.0 – 8.0 (g)	3.0 – 8.0 (g)	0.0 – 5.0 (g)	3.0 – 10.0 (g)	0.0 - 2.5	0 .0- 2.5	0.0 - 2.5	2.0
# 50	6 – 26	8 – 26	10 - 30	5 - 18	10 - 40				4
# 30	10 - 32	16 - 36	20 - 40		20 - 60	2 - 15	2 – 15	2 - 15	5
# 8	28 - 50	40 - 64	40 - 70	20 - 40	60 - 95	10 - 45	10 – 45	10 - 45	6
# 4	40 - 65	55 - 80	65 - 87	30 - 55	80 - 95	40 - 100	40 – 100	40 - 100	7
¼"									
3/8 "	60 - 82	90 - 100	95 - 100	42 - 66	98 - 100	100	100	100	8
½ "	70 - 100	100	100		100				8
¾"	90 - 100			60 - 80					8
1"	100								
2"				100					
Additionally, the fraction of material retained between any two consecutive sieves shall not be less than 4%									
Mixture Temperature									
Binder	325°F maximum					140-185° F			
Aggregate	280-350° F					100-175° F			
Mixtures	**265-325° F**				**275-325°F**	**120-175° F**			**25 °F**
Mixture Properties									
VOIDS - %	3.0 – 6.0 (a)	2.0 – 5.0 (b)	0 – 4.0		0 - 5.0 (a)				
Stability (f) lbs. min.	1200 (c)	1000	1000		1000				
FLOW (f) in.	.08 - .15	.08 - .15	.08 - .18		.08 - .15				
VMA % - min.	15(h) :16 (i)								

3. Superpave Design Method – S0.25, S0.375, S0.5, and S1

a. Requirements: The Contractor or its representative shall design and submit Superpave mix designs annually for approval. The design laboratory developing the mixes shall be approved by the Engineer. The mix design shall be based on the specified Equivalent Single-Axle Loads (ESAL). Each bituminous concrete mix type must meet the requirements shown in Tables M.04.02-2 thru Table M.04.02-5 and in accordance with AASHTO M 323(M) and AASHTO R 35(M). The mix design shall include the nominal maximum aggregate size and a JMF consisting of target values for gradation and bitumen content for each bituminous concrete mix type designated for the project.

The contractor shall provide test results with supporting documentation from an AASHTO Materials Reference Laboratory (AMRL) with the use of NETTCP Certified Technicians for the following tests;

1. Aggregate consensus properties for each type & level, as specified in Table M.04.02-3. In addition the Gsa, Gsb, Pw_a shall also be provided for each component aggregate.

2. New mixes shall be tested in accordance with AASHTO T 283(M) *Standard Method of Test for Resistance of Compacted Hot-Mix Asphalt (HMA) to Moisture-Induced Damage*, (TSR). The compacted specimens may be fabricated at a bituminous concrete facility and then tested at an AMRL accredited facility.

   The AASHTO T 283(M) test results, specimens, and corresponding JMF sheet (Form MAT-429s) shall be submitted by the Contractor for review.

The Contractor shall supply the Engineer with 1 gallon of the specified PG binder and 1 gallon of the same PG binder with the warm mix additive blended into it. The MSDS for the WMA additive shall be included with every submittal.

In addition, minimum binder content values apply to all types of bituminous concrete mixtures, as stated in Table M.04.02-5. For mixtures containing RAP, the virgin production and the anticipated proportion of binder contributed by the RAP cannot be less than the total permitted binder content value for that type nor the JMF minimum binder content.

i. Superpave Mixture (virgin): For bituminous concrete mixtures that contain no recycled material, the limits prescribed in Tables M.04.02-2 thru Table M.04.02-5 apply. The Contractor shall submit a JMF, on a form provided by the Engineer, with the individual fractions of the aggregate expressed as percentages of the total weight of the mix and the source(s) of all materials to the Engineer for approval. The JMF shall indicate the corrected target binder content and applicable binder correction factor (ignition oven or extractor) for each mix type by total weight of mix. The mineral filler (dust) shall be defined as that portion of blended mix that

passes the #200 sieve by weight when tested in accordance with AASHTO T 30(M). The dust-to-effective asphalt (D/Pbe) ratio shall be between 0.6 and 1.2 by weight. The dry/wet mix times and hot bin proportions (batch plants only) for each type shall be included in the JMF.

The percentage of aggregate passing each sieve shall be plotted on a 0.45 power gradation chart and shall be submitted for all bituminous concrete mixtures. This chart shall delineate the percentage of material passing each test sieve size as defined by the JMF. The percentage of aggregate passing each standard sieve shall fall within the specified control points, but outside the restricted zone limits as shown in Tables M.04.02-2 thru Table M.04.02-5. Mixes with documented performance history which pass through the restricted zone may be permitted for use as long as all other physical and volumetric criteria meets specifications as specified in Tables M.04.02-2 thru Table M.04.02-5 and with prior approval from the Engineer. A change in the JMF requires that a new chart be submitted.

ii. Superpave Mixtures with RAP: Use of approved RAP may be allowed with the following conditions:

- RAP amounts up to 15% may be used with no binder grade modification.

- RAP amounts up to 20% may be used provided a new JMF is approved by the Engineer. The JMF submittal shall include the grade of virgin binder added and test results that show the combined binder (recovered binder from the RAP, virgin binder at the mix design proportions and warm mix asphalt additive if used) meets the requirements of the specified binder grade.

Unless approved by the Engineer, RAP material shall not be used with any other recycling option.

b. Basis of Approval: On an annual basis, the Contractor shall submit to the Engineer any bituminous concrete mix design, and JMF anticipated for use on Department projects. Prior to the start of any paving operations, the mix design and JMF must be approved by the Engineer. Bituminous concrete mixture supplied to the project without an approved mix design and JMF will be rejected. The following information must be included in the mix design submittal:

a. Gradation, specific gravities and asphalt content of the RAP,
b. Source of RAP and percentage to be used.
c. Warm mix Technology and manufacturer's recommended additive rate and tolerances, mixing and compaction temperature ranges for the mix with and without the warm-mix technology incorporated.
d. Result of TSR testing, and if applicable Anti-strip manufacturer, and dosage rate.
e. Target Temperature at plant discharge.

Note – Testing to be performed shall be done in accordance with section M.04.03.

The JMF shall be accepted if the Plant mixture and materials meet all criteria as specified in Tables M.04.02-2 thru Table M.04.02-5. If the mixture does not meet the requirements, the contractor shall adjust the JMF within the ranges shown in Tables M.04.02-2 thru Table M.04.02-5 until an acceptable mixture is produced. All equipment, tests, and computations shall conform to the latest AASHTO R-35(M) and AASHTO M-323(M).

Any JMF, once approved, shall only be acceptable for use when it is produced by the designated plant, it utilizes the same component aggregates and binder source, and it continues to meet all criteria as specified herein, and component aggregates are maintained within the tolerances shown in Table M.04.02-2.

The Contractor shall not change any component source of supply including consensus properties after a JMF has been accepted. Before a new source of materials is used, a revised JMF shall be submitted to the Engineer for approval. Any approved JMF applies only to the plant for which it was submitted. Only one mix with one JMF will be approved for production at any one time. Switching between approved JMF mixes with different component percentages or sources of supply is prohibited.

Superpave mixture with CRCG: In addition to subarticles M.04.02 – 3 a through c, for bituminous concrete mixtures that contain CRCG, the Contractor shall submit a materials certificate to the Engineer stating that the CRCG complies with requirements stated in Article M.04.01, as applicable. Additionally, 1% hydrated lime, or other accepted non-stripping agent, shall be added to all mixtures containing CRCG. CRCG material shall not be used with any other recycling option.

c. Mix Status: Each facility will have each type of bituminous concrete mixture evaluated based on the previous year of production, for the next construction paving season, as determined by the Engineer. Based on the rating a type of mixture receives it will determine whether the mixture can be produced without the completion of a PPT. Ratings will be provided to each bituminous concrete producer annually prior to the beginning of the paving season.

The rating criteria are based on compliance with Air Voids and Voids in Mineral Aggregate (VMA) as indicated in Table M.04.03-3: *Superpave Master Range for Bituminous Concrete Mixture Production*, and are as follows:

Criteria A: Based on Air Voids. Percentage of acceptance results with passing air voids.

Criteria B: Based on Air Voids and VMA. The percentage of acceptance results with passing VMA, and the percentage of acceptance results with passing air voids, will be averaged.

The final rating assigned will be the lower of the rating obtained with Criteria A or Criteria B.

Ratings are defined as:

"A" – Approved:
A rating of "A" is assigned to each mixture type from a production facility with a current rating of 70% passing or greater.

"PPT" – Pre-Production Trial:
Rating assigned to each mixture type from a production facility when:

1. there are no passing acceptance production results submitted to the Department from the previous year;
2. there is a source change in one or more aggregate components from the JMF on record by more than 10% by weight;
3. there is a change in RAP percentage ,
4. the mixture has a rating of less than 70% from the previous season;
5. a new JMF not previously submitted.

Bituminous concrete mixtures rated with a "PPT" cannot be shipped or used on Department projects. A passing "PPT" test shall be performed with NETTCP certified personnel on that type of mixture by the bituminous concrete producer and meet all specifications (Table M.04.02-2 Table M.04.02-5) before production shipment may be resumed.
Contractors that have mix types rated a "PPT" may use one of the following methods to change the rating to an "A."

Option A: Schedule a day when a Department inspector can be at the facility to witness a passing "PPT" test or,

Option B: When the Contractor or their representative performs a "PPT" test without being witnessed by an inspector, the Contractor shall submit the test results and a split sample including 2 gyratory molds, 5,000 grams of boxed bituminous concrete for binder and gradation determination, and 5,000 grams of cooled loose bituminous concrete for Gmm determination for verification testing and approval. Passing verifications will designate the bituminous concrete type to be on an "A" status. Failing verifications will require the contractor to submit additional trials.

Option C: When the Contractor or their representative performs a "PPT" test without being witnessed by a Department inspector, the Engineer may verify the mix in the Contractor's laboratory. Passing verifications will designate the bituminous concrete type to be an "A" status. Failing verifications will require the Contractor to submit additional trials.

When Option (A) is used and the "PPT" test meets all specifications, the "PPT" test is considered a passing test and the rating for that mix is changed to "A". When the "PPT" test is not witnessed, the "PPT" Option (B) or (C) procedure must be followed. If the "PPT" Option (B) procedure is followed, the mixtures along with the test results must be delivered to the Materials Testing Lab. The test results must meet the "C" tolerances established by the Engineer. The tolerance Table is included in the Department's current QA Program for Materials, Acceptance and Assurance Testing Policies and Procedures.

"U" – No Acceptable Mix Design on File:

Rating assigned to a type of mixture that does not have a JMF submitted, or the JMF submitted has not been approved, or is incomplete. A mix design or JMF must be submitted annually seven (7) days prior in order to obtain an "A," or "PPT" status for that mix. A "U" will be used only to designate the mix status until the mix design has been approved, and is accompanied with all supporting data as specified. Bituminous concrete mixtures rated with a "U" cannot be used on Department projects.

TABLE M.04.02– 2: SUPERPAVE MASTER RANGE FOR BITUMINOUS CONCRETE MIXTURE DESIGN CRITERIA

Notes: (1) Minimum Pb as specified in Table M.04.02-5. (2) Voids in Mineral Aggregates shall be computed as specified herein. (3) Control point range is also defined as the master range for that mix. (4) Dust is considered to be the percent of materials passing the #200 sieve. (5) For WMA, lower minimum aggregate temperature will require Engineer's approval. (6) For WMA and PMA, the mix temperature shall meet manufacturer's recommendations.

	S0.25				**S0.375**				**S0.5**				**S1**			
Sieve	CONTROL POINTS (3)		*RESTRICTED ZONE*		CONTROL POINTS(3)		*RESTRICTED ZONE*		CONTROL POINTS(3)		*RESTRICTED ZONE*		CONTROL POINTS(3)		*RESTRICTED ZONE*	
inches	Min (%)	Max (%)	*Max (%)*	*Min (%)*	Min (%)	Max (%)	*Min (%)*	*Max (%)*	Min (%)	Max (%)	*Min (%)*	*Max (%)*	Min (%)	Max (%)	*Min (%)*	*Max (%)*
2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.5	-	-	-	-	-	-	-	-	-	-	-	-	100	-	-	-
1.0	-	-	-	-	-	-	-	-	-	-	-	-	90	100	-	-
3/4	-	-	-	-	-	-	-	-	100	-	-	-	-	90	-	-
1/2	100	-	-	-	100	-	-	-	90	100	-	-	-	-	-	-
3/8	97	100	-	-	90	100	-	-	-	90	-	-	-	-	-	-
#4	-	90	-	-	-	90	-	-	-	-	-	-	-	-	*39.5*	*39.5*
#8	32	67	*47.2*	*47.2*	32	67	*47.2*	*47.2*	28	58	*39.1*	*39.1*	19	45	*26.8*	*30.8*
#16	-	-	*31.6*	*37.6*	-	-	*31.6*	*37.6*	-	-	*25.6*	*31.6*	-	-	*18.1*	*24.1*
#30	-	-	*23.5*	*27.5*	-	-	*23.5*	*27.5*	-	-	*19.1*	*23.1*	-	-	*13.6*	*17.6*
#50	-	-	*18.7*	*18.7*	-	-	*18.7*	*18.7*	-	-	*15.5*	*15.5*	-	-	*11.4*	*11.4*
#100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
#200	2.0	10.0	-	-	2.0	10.0	-	-	2.0	10.0	-	-	1.0	7.0	-	-
Pb (1)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
VMA (2) (%)	16.0 ± 1				16.0 ± 1				15.0 ± 1				13.0 ± 1			
VA (%)	4.0 ± 1				4.0 ± 1				4.0 ± 1				4.0 ± 1			
Gse	JMF value				JMF value				JMF value				JMF value			
Gmm	JMF ± 0.030				JMF ± 0.030				JMF ± 0.030				JMF ± 0.030			
Dust/Pbe(4)	0.6 – 1.2				0.6 – 1.2				0.6 – 1.2				0.6 – 1.2			
Agg. Temp(5)	280 – 350F				280 – 350F				280 – 350F				280 – 350F			
Mix Temp(6)	265 – 325 F				265 – 325 F				265 – 325 F				265 – 325 F			
Design TSR	≥ 80%				≥ 80%				≥ 80%				≥ 80%			
T-283 Stripping	Minimal, as determined by the Engineer															

TABLE M.04.02–3
SUPERPAVE MASTER RANGE FOR CONSENSUS PROPERTIES OF COMBINED AGGREGATE STRUCTURES

Notes: (1) If less than 25 % of a given layer is within 4 inches of the anticipated top surface, the layer may be considered to be below 4 inches for mixture design purposes.

Traffic Level	Design ESALs (80 kN)	Coarse Aggregate Angularity (1) ASTM D 5821	Fine Aggregate Angularity (7) AASHTO T 304	Flat or Elongated Particles ASTM D 4791	Sand Equivalent AASHTO T 176
-----	(million)			>#4	-----
1*	< 0.3	55/- -	40	10	40
2	0.3 to < 3.0	75/- -	40	10	40
3	≥ 3.0	95/90	45	10	45
	Design ESALs are the anticipated project traffic level expected on the design lane, projected over a 20 year period, regardless of the actual expected design life of the roadway.	Criteria presented as minimum values. 95/90 denotes that a minimum of 95% of the coarse aggregate, by mass, shall have one fractured face and that a minimum of 90% shall have two fractured faces.	Criteria presented as minimum percent air voids in loosely compacted fine aggregate passing the #8 sieve.	Criteria presented as maximum Percent by mass of flat or elongated particles of materials retained on the #4 sieve, determined at 3:1 ratio.	Criteria presented as minimum values for fine aggregate passing the #8 sieve.

*** NOTE: Level 1 for use by Towns and Municipalities ONLY.**

TABLE M.04.02– 4: SUPERPAVE MASTER RANGE FOR TRAFFIC LEVELS AND DESIGN VOLUMETRIC PROPERTIES.

Traffic Level	Design ESALs	Number of Gyrations by Superpave Gyratory Compactor			Percent Density of Gmm from HMA/WMA specimen			Voids Filled with Asphalt (VFA) Based on Nominal mix size – inch			
	(million)	Nini	Ndes	Nmax	Nini	Ndes	Nmax	0.25	0.375	0.5	1
1*	< 0.3	6	50	75	≤ 91.5	96.0	≤ 98.0	70 - 80	70 - 80	70 - 80	67 - 80
2	0.3 to < 3.0	7	75	115	≤ 90.5	96.0	≤ 98.0	65 - 78	65 - 78	65 - 78	65 - 78
3	≥ 3.0	8	100	160	≤ 90.0	96.0	≤ 98.0	73 – 76	73 - 76	65 - 75	65 - 75

*** NOTE: Level 1 for use by Towns and Municipalities ONLY.**

TABLE M.04.02– 5: SUPERPAVE MINIMUM BINDER CONTENT BY MIX TYPE & LEVEL.

Mix Type	Level	Binder Content Minimum [1]
S0.25	1*	5.6
S0.25	2	5.5
S0.25	3	5.4
S0.375	1*	5.6
S0.375	2	5.5
S0.375	3	5.4
S0.5	1*	5.0
S0.5	2	4.9
S0.5	3	4.8
S1	1*	4.6
S1	2	4.5
S1	3	4.4

*** NOTE: Level 1 for use by Towns and Municipalities ONLY.**

M.04.03— Production Requirements:

1. Quality Control Plan and Processes: The Contractor shall submit a Quality Control Plan (QCP) for bituminous concrete production specifically for the plant producing the bituminous concrete mixture for review and approval of the Engineer on an annual basis.

The QCP shall describe the organization and procedures which the Contractor shall use to administer quality control. The QCP shall include the procedures used to control the production process, to determine when immediate changes to the processes are needed, and to implement the required changes. The QCP must detail the inspection, sampling and testing protocols to be used, and the frequency for each.

Control Chart(s) shall be developed and maintained for critical aspect(s) of the production process as determined by the Contractor. The control chart(s) shall identify the material property, applicable upper and lower control limits, and be updated

with current test data. The control chart(s) shall be used as part of the quality control system to document variability of the bituminous concrete production process. The control chart(s) shall be submitted to the Engineer upon request.

The QCP shall also include the name and qualifications of a Quality Control Manager. The Quality Control Manager shall be responsible for the administration of the QCP, including compliance with the plan and any plan modifications. All daily QC sampling, inspection and test reports shall be reviewed by the Quality Control Manager and be submitted to the Engineer upon request.

The QCP shall also include the name and qualifications of any outside testing laboratory performing any QC functions on behalf of the Contractor. The QCP must also include a list of sampling & testing methods and frequencies used during production, and the names of all Quality Control personnel and their duties.

Approval of the QCP does not imply any warranty by the Engineer that adherence to the plan will result in production of bituminous concrete that complies with these specifications. The Contractor shall submit any changes to the QCP as work progresses.

2. **Acceptance Sampling & Testing Methods:** Acceptance samples of mixtures shall be obtained from the hauling vehicles and tested by the Contractor at the facility during each day's production.

The hauling vehicle from which samples are obtained shall be selected using stratified – random sampling based on the total estimated tons of production in accordance with ASTM D 3665, except that the first test shall be randomly taken from the first 151 tons or as directed by the Engineer.

The number of sub lots and tests required per sub lot is based on the total estimated tons of production per day as indicated in Table M.04.03-1. Quantities of the same type/level mix per plant may be combined daily for multiple state projects to determine the number of sub lots.
The payment adjustment for air voids and liquid binder will be calculated per sub lot as described in Section 4.06.

An acceptance test shall not be performed within 150 tons of production from a previous acceptance test unless approved by the Engineer. Quality Control tests are not subject to this restriction. Unless otherwise tested, a minimum of one (1) acceptance test

shall be performed for every four days of production at a facility for each type/level mix (days of production may or may not be consecutive days).

The Contractor shall submit all acceptance tests results to the Engineer within 24 hours or prior to the next day's production. All acceptance test specimens and supporting documentation must be retained by the Contractor. Verification testing will be performed by the Engineer on the retained specimens in accordance with the Department's QA Program for Materials.

Should the Department be unable to verify the Contractor's acceptance test result(s) due to a failure of the Contractor to retain acceptance test specimens or supporting documentation, the Contractor shall review its quality control plan, determine the cause of the nonconformance and respond in writing within 24 hours to the Engineer describing the corrective action taken at the plant. In addition the Contractor must provide supporting documentation or test results to validate the subject acceptance test result(s). The Engineer may invalidate any positive adjustments for material corresponding to the acceptance test(s). Failure of the Contractor to adequately address quality control issues at a facility may result in suspension of production for Department projects at that facility.

Contractor personnel performing acceptance sampling and testing must be present at the facility prior to, and during production, and be certified as a NETTCP HMA Plant Technician or Interim HMA Plant Technician and be in good standing. Production of material for use on State projects must be suspended by the Contractor if such personnel are not present.

Technicians found by the Engineer to be non-compliant with NETTCP or Department policies may be removed by the Engineer from participating in the acceptance testing process for Department projects until their actions can be reviewed.

Anytime during production that testing equipment becomes inoperable, production can continue for a maximum of 1 hour. The Contractor shall obtain box sample(s) in accordance with Table M.04.03-1 to satisfy the daily acceptance testing requirement for the quantity shipped to the project. The box sample(s) shall be tested once the equipment issue has been resolved to the satisfaction of the Engineer. Production beyond 1 hour may be considered by the Engineer. Production will not be permitted beyond that day until the subject equipment issue has been resolved.

Table M.04.03 – 1: Acceptance Testing Frequency per Type/Level/Plant

Daily quantity produced in tons (lot)	Number of Sub Lots/Tests
0 to 150	0, Unless requested by the Engineer
151 to 600	1
601 to 1,200	2
1,201 to 1,800	3
1,801 or greater	1 per 600 tons or portions thereof

i. Marshall Mix Acceptance Sampling and Testing Procedures: When the Marshall mix design is specified, the following acceptance procedures and AASHTO test methods shall be used:

Table M.04.03 – 2: Marshall Acceptance Test Procedures

Protocol	Reference	Description
1	**AASHTO T 30(M)**	Mechanical Analysis of Extracted Aggregate
2	**AASHTO T 40(M)**	Sampling Bituminous Materials
3	**AASHTO T 308(M)**	Binder content by Ignition Oven method (adjusted for aggregate correction factor)
4	**AASHTO T 245(M)**	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
5	**AASHTO T 209(M)**	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
6	**AASHTO T 269(M)**	Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
7	**AASHTO T 329**	Moisture Content of Hot-Mix Asphalt (HMA) by Oven Method

a. Cessation of Supply: Marshall Mix Production shall cease for the Project from any facility that consistently fails to produce mixture that meets the JMF and volumetric properties. The criteria for ceasing the supply of a class of mixture from any plant are as follows:

   i. Off-Test Status: The results of AASHTO T 164 or AASHTO T 308(M) and T 30(M) will be used to determine if the mixture is within the tolerances shown in Table M.04.02-1. The Contractor will be notified that a plant is "off test" for a class of mixture when the test results indicate that any single value for bitumen content or gradation are not within the tolerances shown in Table M.04.02-1 for that class of mixture.
   ii. When multiple plants and silos are located at one site, mixture supplied to one project is considered as coming from one source for the purpose of applying the “off test” adjusted payment.
   iii. If a test indicates that the bitumen content or gradation are outside the tolerances, the Contractor may make a single JMF change on classes 1, 2, 3, 4 and 12 as allowed by the Engineer prior to any additional testing. A JMF change shall include the date and name of the Engineer that allowed it. Consecutive test results outside the requirements of Table M.04.02-1 JMF tolerances may result in rejection of the mixture.

iv. The Engineer may cease supply of mixture from the plant when the test results from three non-consecutive samples of a class of mixture are not within the JMF tolerances or the test results from two non-consecutive samples not within the master range indicated in Table M.04.02-1 during any one production period, due to inconsistent production.

v. Any modification to the JMF shall not exceed 50% of the JMF tolerances indicated in Table M.04.02-1 for any given component of the mixture without approval of the Engineer. When such an adjustment is made to the bitumen, the corresponding production percentage of bitumen shall be revised accordingly.

b. Adjustments for Off Test Mixture under Cessation of Supply: The bituminous concrete plant shall cease supplying to the project:

i. When the test results from three consecutive samples are "off test" and not within the JMF tolerances or,

ii. The test results from two consecutive samples are "off test" and not within the ranges indicated in Table M.04.02 – 1 or,

iii. When the percent of material passing the minus #200 sieve material exceeds the percent of extracted bitumen content for three consecutive samples during any production period of the values stated in Table M.04.02-1:

a. The quantity of mixtures shipped to the project determined to be "off test" and outside the tolerances will be tabulated by the Engineer and will be adjusted in accordance with Section 4.06.

b. Following cessation, a trial production period will be required at the plant for that class of mixture. Use of that class of mixture from that plant will be prohibited on the Project until the plant has demonstrated the ability to consistently produce acceptable mixture.

c. When the Engineer has accepted the mixtures from the trial production period, the use of that mixture on the Project may resume.

ii. Superpave Mix Acceptance Sampling and Testing Procedures: When the Superpave mix design is specified, the following acceptance and AASHTO test procedures shall be used:

Table M.04.03– 3: Superpave Acceptance Testing Procedures

Protocol	Reference	Description
1	AASHTO T 168(M)	Sampling of bituminous concrete
2	AASHTO T 308(M)	Binder content by Ignition Oven method (adjusted for aggregate correction factor)
3	AASHTO T 30(M)	Gradation of extracted aggregate for bituminous concrete mixture
4	AASHTO T 312(M)	(1)Superpave Gyratory molds compacted to N_{des}
5	AASHTO T 166(M)	(2)Bulk specific gravity of bituminous concrete
6	AASHTO R 35(M)	(2)Air voids, VMA
7	AASHTO T 209(M)	Maximum specific gravity of bituminous concrete (average of two tests)
8	AASHTO T 329	Moisture content of Production bituminous concrete

The Contractor shall perform moisture susceptibility (TSR) testing annually for all design levels of HMA-, WMA-, and PMA- S0.5 plant-produced mixtures, in accordance with the latest version of AASHTO T 283(M).

If any material source changes from the previous year, or during the production season, a mix design TSR as well as a production TSR is required for the new mixture. The AASHTO T 283(M) test shall be performed at an AASHTO Materials Reference Laboratory (AMRL) by NETTCP Certified Technicians. The test results and specimens shall be submitted to the Engineer for review. This shall be completed within 30 days from the start of production. Superpave mixtures that require anti-strip additives (either liquid or mineral) shall continue to meet all requirements specified herein for binder and bituminous concrete. The Contractor shall submit the name, manufacturer, percent used, and MSDS sheet for the anti-strip additive (if applicable) to the Engineer. In addition, compaction of samples shall be accomplished utilizing an accepted Superpave Gyratory Compactor (SGC), supplied by the Contractor. The SGC shall be located at the facility supplying mixture to the project.

a. <u>Determination of Off-Test Status:</u>

i. Off Test Status: Superpave mixes shall be considered *"off test"* when any Control Point Sieve, VA, VMA, and Gmm values are outside of the limits specified in Table M.04.03-3 and the computed binder content (Pb) established by AASHTO T308(M) or as documented on the vehicle delivery ticket is below the minimum binder content stated in sub article M.04.03-5. Note that further testing of samples or portions of samples not initially tested for this purpose cannot be used to change the status.

ii. Any time the bituminous concrete mixture is considered Off-test:

1. The Contractor shall notify the Engineer (and project staff) when the plant is *"off test"* for a type of mixture. When multiple plants and silos are located at one site, mixture supplied to one project is considered as coming from one source for the purpose of applying the *"off test"* determination.

2. The Contractor must take immediate actions to correct the deficiency, minimize *"off test"* production to the project, and obtain an additional Process Control (PC) test after any corrective action to verify production is in conformance to the specifications. A PC test will not be used for acceptance and is solely for the use of the Contractor in its quality control process.

b. Cessation of Supply for Superpave Mixtures with no Payment Adjustment: Production of bituminous concrete shall cease for the Project from any plant that consistently fails to produce mixture that meets the JMF and volumetric properties. The quantity of Superpave mixtures shipped to the project that is "off-test" will not be adjusted for deficient mixtures.

A Contractor shall cease to supply mixture from a plant when:

1. Bituminous concrete mixture is "off test" on three (3) consecutive tests for VMA or Gmm, regardless of date of production due to inconsistency (i.e., small production requires 1 test per day for multiple days).

2. Bituminous concrete mixture is "off test" on two (2) consecutive tests for the Control Point sieves in one day's production.

Following cessation, the Contractor shall immediately make necessary material or process corrections and run a Pre-Production Trial (PPT) for that type of mixture. Use of that type of mixture from that plant will be prohibited on the Project until the Contractor has demonstrated the ability to produce acceptable mixture from that facility. When the

Contractor has a passing test and has received approval from the Engineer, the use of that mixture to the Project may resume.

c. Cessation of Supply for Superpave Mixtures with Payment Adjustment:
Production of bituminous concrete shall cease for the Project from any plant that consistently fails to produce mixture that meets the Superpave minimum binder content by mix type and level listed in Table M.04.02-5. The quantity of Superpave mixtures shipped to the project that is "off-test" will be adjusted for deficient mixtures in accordance with Section 4.06.

A Contractor shall cease to supply mixture from a plant when the binder content (Pb) is below the requirements of Table M.04.03-5 on the ignition oven test result after two (2) consecutive tests, regardless of the date of production.

Following cessation, the Contractor shall immediately make necessary material or process corrections and run a Pre-Production Trial (PPT) for that type of mixture. Use of that type of mixture from that plant will be prohibited on the Project until the Contractor has demonstrated the ability to produce acceptable mixture from that facility. When the Contractor has a passing test and has received approval from the Engineer, the use of that mixture to the Project may resume.

d. JMF Changes for Superpave Mixture Production: It is understood that a JMF change is effective from the time it was submitted forward and is not retroactive to the previous test or tests. JMF changes are permitted to allow for trends in aggregate and mix properties but every effort shall be employed by the Contractor to minimize this to ensure a uniform and dense pavement.

JMF changes to the G_{mm} or mix Absorption Correction Factor (A_{cf}) are only permitted prior to or after a production shift for all bituminous-concrete types of mixtures and only when they:

i. Are requested in writing and pre-approved by the Engineer;
ii. Are based on a minimum of a two test trend;
iii. Are documented with a promptly submitted revised JMF on form provided by the Engineer.
iv. A revised JMF submittal shall include the date and name of the Engineer that allowed it.

TABLE M.04.03– 3: SUPERPAVE MASTER RANGE FOR BITUMINOUS CONCRETE MIXTURE PRODUCTION

Notes: (1) 300°F minimum after October 15. (2) Minimum Pb as specified in Table M.04.03-5 (3) Control point range is also defined as the master range for that mix. (4) JMF tolerances shall be defined as the limits for production compliance. VA & Pb payment is subject to adjustments, as defined in sub-article 4.06.04 - 2. (5) For WMA, lower minimum aggregate temperature will require Engineer's approval. (6) For WMA and/or polymer modified asphalt, the mix temperature shall meet manufacturer's recommendations. In addition, for WMA, the maximum mix temperature shall not exceed 325°F once the WMA technology is incorporated.

	S0.25		**S0.375**		**S0.5**		**S1**		**Tolerances**
Sieve	CONTROL POINTS (4)		CONTROL POINTS (4)		CONTROL POINTS (4)		CONTROL POINTS (4)		**JMF Limits** (4)
inches	Min(%)	Max(%)	Min(%)	Max(%)	Min(%)	Max(%)	Min(%)	Max(%)	±Tol
2.0	-	-	-	-	-	-	-	-	
1.5	-	-	-	-	-	-	100	-	
1.0	-	-	-	-	-	-	90	100	
3/4	-	-	-	-	100	-	-	90	
1/2	100	-	100	-	90	100	-	-	
3/8	97	100	90	100	-	90	-	-	
#4	-	90	-	90	-	-	-	-	
#8	32	67	32	67	28	58	19	45	
#16	-	-	-	-	-	-	-	-	
#200	2.0	10.0	2.0	10.0	2.0	10.0	1.0	7.0	
Pb(2)	-	-	-	-	-	-	-	-	note (2)
VMA (%)	16.0		16.0		15.0		13.0		1.0
VA (%)	4.0		4.0		4.0		4.0		1.0
Gmm	JMF value		JMF value		JMF value		JMF value		0.030
Agg. Temp (5)	280 – 350F		280 – 350F		280 – 350F		280 – 350F		
Mix Temp (6)	265 – 325 F (1)		265 – 325 F (1)		265 – 325 F (1)		265 – 325 F (1)		
Prod. TSR	N/A		N/A		≥80%		N/A		
T-283 Stripping	N/A		N/A		Minimal as determined by the Engineer		N/A		

TABLE M.04.03– 4: SUPERPAVE MASTER RANGE FOR TRAFFIC LEVELS AND DESIGN VOLUMETRIC PROPERTIES.

Traffic Level	Design ESALs (million)	Number of Gyrations by Superpave Gyratory Compactor	
		Nini	Ndes
1*	< 0.3	6	50
2	0.3 to < 3.0	7	75
3	≥3.0	8	100

*** NOTE: Level 1 for use by Towns and Municipalities ONLY.**

TABLE M.04.03– 5: SUPERPAVE MINIMUM BINDER CONTENT BY MIX TYPE & LEVEL.

Mix Type	Level	Binder Content Minimum (1)
S0.25	1*	5.6
S0.25	2	5.5
S0.25	3	5.4
S0.375	1*	5.6
S0.375	2	5.5
S0.375	3	5.4
S0.5	1*	5.0
S0.5	2	4.9
S0.5	3	4.8
S1	1*	4.6
S1	2	4.5
S1	3	4.4

*** NOTE: Level 1 for use by Towns and Municipalities ONLY.**

Table M.04.03-6:
Modifications to Standard AASHTO and ASTM Test Specifications and Procedures.

AASHTO Standard Specification	
Reference	**Modification**
M 320	1. Mass change for PG 64-22 shall be a maximum loss of 0.5% when tested in accordance with AASHTO T 240. 2. The two bottles used for the mass change determination may be re-heated and used for further testing.
AASHTO Standard Methods of Test	
Reference	**Modification**
T 27	Section 7.7 Samples are not washed
T 30	Section 6.2 thru 6.5 Samples are not routinely washed
T 168	Samples are taken at one point in the pile. All types of bituminous concrete except Class 4 are scooped from the sample container instead of remixing and quartering. (Method verified by laboratory study). Samples from a hauling vehicle are taken from only one point instead of three as specified. Selection of Samples: Sampling is equally important as the testing, and the sampler shall use every precaution to obtain samples that are truly representative of the bituminous mixture. Box Samples: In order to enhance the rate of processing samples taken in the field by construction or maintenance personnel the samples will be tested in the order received and data processed to be determine conformance to material specifications and to prioritize inspections by laboratory personnel.
T 195	Section 4.3 only one truck load of mixture is sampled. Samples are taken from opposite sides of the load.
T 209	Article 9.5.1 Bowl is suspended 2 minutes prior to reading rather than 10 minutes. This makes no significant difference in results. Section 7.2 The average of two bowls is used proportionally in order to satisfy minimum mass requirements. 8.3 Omit Pycnometer method.
T 245	Article 3.3.2 A compacting temperature of 140 to 146°C (284 to 295°F) is used Article 3.5.2 Seventy-five (75) blows per side are used on Classes 1 and 12, per ConnDOT design requirements Section 3.1 for production testing: one specimen is molded for each extraction test for production over 275 metric tons/day (300 tons/day). Other mixtures: two specimens per extraction test.
T 283	When foaming technology is used, the material used for the fabrication of the specimens shall be cooled to room temperature, and then reheated to the manufactures recommended compaction temperature prior to fabrication of the

	specimens.
T 308	In addition to the standard testing procedure, the Department has adopted a procedure that addresses a correction factor that is calculated using the composite aggregate percentages (**C**omposite **A**ggregate **C**orrection **F**actor **M**ethod **(CACF)**). The aggregate is burned in compliance with the standard AASHTO procedure Method A exclusively. All modifications are listed for this method only. A2.2 and A2.3 Omit A2.4 Omit. Replace with: Determine an aggregate gradation for each aggregate component "blank" in accordance with T30. A2.5 Omit. Replace with: The individual aggregate samples are to be dried in an oven at a maximum temperature of 148 ± 5ºC (300 ± 9º F) to a constant weight. RAP samples are to be oven dried at a maximum temperature of 110 ± 5ºC (230 ± 9º F) to a constant weight. RAP samples will be burned for total binder content only and not to arrive at a correction factor for a mixture. A2.6 and A2.7 and A2.8 Omit. A2.8.1 Omit Note 2 A2.9 Omit. Replace with: Perform a gradation analysis on the residual aggregate in accordance with T30 and compare it to the gradation performed prior to burning. A2.9.1 and A2.9.2 Omit The correction factors for each size aggregate are provided by the Contractor to the Engineer prior to the Annual Plant Inspection. The Engineer may verify the correction factors. The Composite Aggregate Correction Factor (CACF) for any mixture may be calculated by summing the result of the correction factor for each individual aggregate multiplied by the percentage of that aggregate in the overall mixture. (Note: All correction factors must be re-calculated every time the percentage of any aggregate changes within the mixture.) If the average corrected Pb content from the ignition oven differs by 0.3% or more from the average bituminous concrete facility production weigh ticket in five (5) consecutive tests regardless of the production date (moving average), the Contractor shall immediately investigate, determine an assignable cause and correct the issue. When two consecutive moving average differences are 0.3% or more, the Engineer may require a new correction factor calculation for all the aggregate components in the mix. In addition to the standard testing procedure, the Department has adopted a procedure that addresses the time involved between sampling the hot-mix asphalt specimen and the beginning of the test. 6.3 Omit. Replace with: The test specimen must be ready to be placed in an approved ignition furnace for testing within ten minutes of being obtained from the hauling vehicle and the test shall start immediately after.

T 331	6.1 Cores are dried to a constant mass prior to testing using a core-dry machine.

AASHTO Standard Recommended Practices

Reference	Modification
R 35	**<u>Volumetric Calculations of VMA and Correction Factor</u>** VMA_a - Voids in Mineral Aggregate from (Va + Vbe) the mix: A. VMA calculated from the mix shall be determined in accordance with *Formula 5.16.1A.* It can be correlated that the VMA calculated from AASHTO R-35 is equivalent to VMA_a when the Pb_a x (100-Pb_t) / 100 is known and substituted for A_{cf}, as shown in *Formula 5.16.1A (ii).* Test results from VMA_a shall therefore be required to meet all contract specifications. Values of VMA_a that are out of specifications during production may be cause for the contractor to determine assignable reason, take corrective action, and modify the Job Mix Formula (JMF), as needed. Continued VMA_a data that is out of specifications may be cause for the Engineer to order cessation of supply. *Formula 5.16.1A.* Determining the VMA of bituminous concrete by the mix or air voids & effective binder method: $$VMA_a = V_a + \left[\frac{(Gmb_d \times (Pb_t - A_{cf})}{G_b} \right]$$ Where: VMA_a = VMA calculated from plant production mix(V_a + Vb_e) Gmb_d = Bulk specific gravity as determined by AASHTO T 166(M) Pb_t = Total Binder Content (corrected) by AASHTO T 308(M) A_{cf} = Absorption correction factor provided by Contractor (refer to B. i and ii) B. Determining the bituminous concrete mix binder correction factor for each class by use of percent absorption of water by AASHTO T 84/85, AASHTO M 323 and D_f method. This value shall be performed by the Contractor during the mix design only and submitted as a JMF value. Two methods for determining the A_{cf} are shown, although method (i) will be the desired method to be used. Both methods are equivalent when the Gsa, Gsb and Pwa are recent and valid for the mix. *i.* $A_{cf} = Df \times Pwa \times (100 - Pb_t) / 100$ *ii.* $A_{cf} = (Pb_a \text{ from annual JMF submittal}) \times (100 - Pb_t) / 100$ Where: Df = as determined by Formula 5.16.1B. Pwa = as determined by AASHTO T 84/85 Pb_a = as determined by AASHTO M 323 (from annual JMF submittal) D_f (Density Factor): The Contractor shall calculate the bituminous concrete

	mix design D_f (*derived from formula X1.2 APPENDIX X1 of AASHTO R 35)* for each class of material, in accordance with *Formula 5.16.1B*. *Formula 5.16.1B*. Determining the Density Factor *(D_f)* of mix design bituminous concrete: $$D_f = \left(\frac{Gse - Gsb}{Gsa - Gsb}\right)$$ Where: D_f = Density Factor or multiplier determined by AASHTO R-35(M) Gse = Effective Specific Gravity determined by AASHTO M-323 at plant Gsa = Apparent Specific Gravity determined by AASHTO T 84/85 of mix design Gsb = Bulk Specific Gravity determined by AASHTO T 84/85 of mix design
R 26	Quality Control Plans must be formatted in accordance with AASHTO R 26, certifying suppliers of performance-graded asphalt binders, Section 9.0, Suppliers Quality Control Plan, and "NEAUPG Model PGAB QC Plan." 1. The Department requires that all laboratory technician(s) responsible for testing PG-binders be certified or Interim Qualified by the New England Transportation Technician Certification Program (NETTCP) as a PG Asphalt Binder Lab Technician. 2. Sampling of asphalt binders should be done under the supervision of qualified technician. NECTP "Manual of Practice," Chapter 2 Page 2-4 (Key Issues 1-8). 3. A copy of the Manual of Practice for testing asphalt binders in accordance with the Superpave PG Grading system shall be in the testing laboratory. 4. All laboratories testing binders for the Department are required to be accredited by the AASHTO Materials Reference Laboratory (AMRL). 5. Sources interested in being approved to supply PG-binders to the Department by use of an "in-line blending system," must record properties of blended material, and additives used. 6. Each source of supply of PG-binder must indicate that the binders contain no additives used to modify or enhance their performance properties. Binders that are manufactured using additives, modifiers, extenders etc., shall disclose the type of additive, percentage and any handling specifications/limitations required. Suppliers shall provide AASHTO M-320 Table 2 testing at a minimum of once per month on one sample of material. Each supplier shall rotate the PG grade each month (including polymer-modified asphalt (PMA)), so that data can be collected for all the grades produced.

NOTICE TO CONTRACTOR - TRAFFIC DRUMS AND TRAFFIC CONES

Traffic Drums and 42-inch (1 m) Traffic Cones shall have four six-inch (150 mm) wide stripes (two - white and two - orange) of flexible bright fluorescent sheeting.

The material for the stripes shall be one of the following, or approved equal:

- 3M Scotchlite Diamond Grade Flexible Work Zone Sheeting, Model 3910 for the white stripes and Model 3914 for the orange stripes,

- Avery Dennison WR-7100 Series Reboundable Prismatic Sheeting, Model WR-7100 for the white stripes and Model WR-7114 for the orange stripes.

NOTICE TO CONTRACTOR - GENERAL PERMIT FOR STORMWATER DISCHARGE

This Notice is provided to summarize the requirements of the Connecticut Department of Environmental Protection's General Permit for Stormwater Discharges (GPSD) from Construction Activities issued on October 1, 2002, modified April 8, 2004, reissued October 1, 2007 and reissued (without modification) October 1, 2008. When construction activities will result in the disturbance of a total of 1 acre or more of land within the project limits, the Department must insure compliance with all conditions of this Permit (GPSD). `Construction Activities' as defined in the GPSD include, but are not limited to, the following; clearing, grubbing, grading, excavation, placement of fill, and dewatering activities.

The Department has incorporated a 'Stormwater Pollution Control Plan' (SPCP) within the contract documents in order to insure compliance with the conditions of the GPSD. The SPCP addresses pollution caused by soil erosion and sedimentation during and after construction as well as the long term use of the facility after construction is completed. A copy of the GPSD is included in the contract special provisions. The Contractor will be required to comply with all applicable conditions of the GPSD. The Contractor and all subcontractors must sign a certification as stated in the GPSD (see page 20, Item E. Contractors). There will be no additional payment for the Contractor to sign the certification and no additional payment for the Contractor to comply with the conditions of the GPSD.

The Engineer will be the registrant and Permittee for the purposes of filing the registration.

If the Contractor proposes activities which require modifications to the Stormwater Pollution Control Plan prior to the start of construction, he must notify the Department in writing within 30 days of submitting the apparent low bid. The Department shall approve or reject the plan and notify the Contractor in writing as to any revisions required for approval, within 30 days of the date of the Contractor's submission. No damage for delays will be granted due to the Contractor's failure to provide a suitable plan and certification. Any modifications to the contract must also conform to the requirements of Section 1.10 - Environmental Compliance, of the Standard Specifications and any Supplements thereto. If the Contractor modifies his activities after the registration has been submitted and construction has begun, so that the SPCP is no longer in compliance with the GPSD, then the Contractor will be responsible for updating the Stormwater Pollution Control Plan. No additional payment will be made for revisions to the Stormwater Pollution Control Plan required as a result of the Contractor's modifications to the contract. The Contractor must submit all revisions in writing to the Engineer for approval. Under no circumstances can the Contractor proceed with activities which require revisions to the Stormwater Pollution Control Plan until approval is obtained from the Engineer.

NOTICE TO CONTRACTOR - UTILITY SPECIFICATIONS

The contractor is hereby notified that all utility specifications contained elsewhere herein shall be made a part of this contract, and that the contractor shall be bound to comply with all requirements of such specifications. The requirements and conditions set forth in the subject specifications shall be binding on the contractor just as any other specification would be.

SECTION 1.01 – DEFINITIONS OF TERMS AND PERMISSIBLE ABBREVIATIONS

1.01.01--Definitions:

Delete the following term:

"**SHOP DRAWINGS:** Drawings, including . . . in the Contract."

Add the following terms:

PEER REVIEWER: The independent third party review required reviewing the primary structural system for the Project.

STRUCTURAL ENGINEER: An engineer licensed in the State of Connecticut, hired by the Contractor to perform the work described in NOTICE TO CONTRACTOR – THRESHOLD BUILDING DESIGN AND CALCULATION SUBMISSION REQUIREMENTS.

SECTION 1.02 – PROPOSAL REQUIREMENTS AND CONDITIONS

Article 1.02.04 – Examination of Plans, Specifications, Special Provisions and Site of Work:

Replace the third sentence of the last paragraph with:

The Department cannot ensure a response to inquiries received later than ten (10) days prior to the original scheduled opening of the related bid.

SECTION 1.03 - AWARD AND EXECUTION OF CONTRACT

Article 1.03.08 - Notice to Proceed and Commencement of Work:

Change the first paragraph to read as follows:

> "The Contractor shall commence and proceed with the Contract work on the date specified in a written notice to proceed issued by the Engineer to the Contractor. The date specified will be no later than 45 calendar days after the date of the execution of the Contract by the Department".

1.03.07--Insurance:

Delete #9 in its entirety and replace with the following:

"9. **Architects and Engineer's Professional Liability Insurance:** When the Contractor is specifically required to make submittals to the Department which require the stamp of a Professional Engineer licensed in the State of Connecticut, these submittals shall include a copy of the liability insurance policy for the Professional Engineer. The Professional Liability Insurance shall have a minimum of $1,000,000 coverage and shall be provided and maintained at no direct cost to the State. The policy shall be maintained for a period of the lesser of (1) a period of 3 years from the date of the acceptance of the Project by the Commissioner, as evidenced by the State of Connecticut, Department of Transportation form entitled "Certificate of Acceptance of Work and Acceptance of Project" issued to the Contractor; or (2) a period of 3 years after the termination of the Contract, subject to the continued commercial availability of such insurance."

1.03.08--Notice to Proceed and Commencement of Work:

Delete the first paragraph and replace with the following:

"The Contractor shall commence and proceed with the Contract work on the date specified in a written Notice to Proceed issued by the Engineer to the Contractor. The date specified will be no later than 45 calendar days after the date of the execution of the Contract by the Department."

SECTION 1.05 – CONTROL OF THE WORK

1.05.02--Plans, Working Drawings, and Shop Drawings:

Delete the entire subsection entitled "2. Working Drawings:"

Delete the entire subsection entitled "3. Shop Drawings:"

SECTION 1.06 – CONTROL OF MATERIALS

1.06.01--Source of Supply and Quality:

Delete the last paragraph: "When one manufacturer's product . . . and Materials Certificate."

1.06.08--Warranties, Guarantees and Instruction Sheets:

Delete the entire Article.

SECTION 1.07 - LEGAL RELATIONS AND RESPONSIBILITIES

Article 1.07.10 - Contractor's Duty to Indemnify the State against Claims for Injury or Damage:

Add the following after the only paragraph:

"It is further understood and agreed by the parties hereto, that the Contractor shall not use the defense of Sovereign Immunity in the adjustment of claims or in the defense of any suit, including any suit between the State and the Contractor, unless requested to do so by the State."

SECTION 1.08 – PROSECUTION AND PROGRESS

1.08.01--Transfer of Work or Contract:

In the first sentence of the first paragraph which reads: "The Contractor shall perform . . . total Contract value.", change "50%" to "40%."

1.08.04 - Limitation of Operations - Add the following:

In order to provide for traffic operations as outlined in the Special Provision "Maintenance and Protection of Traffic," the Contractor will not be permitted to perform any work which will interfere with the described traffic operations on all project roadways as follows:

Route 262

Monday through Friday between 6:00 a.m. and 9:00 a.m. & between 3:00 p.m. and 6:00 p.m.
Saturday and Sunday between 10:00 a.m. and 6:00 p.m.

Additional Lane Closure Restrictions

It is anticipated that work on adjacent projects will be ongoing simultaneously with this project. The Contractor shall be aware of those projects and anticipate that coordination will be required to maintain proper traffic flow at all times on all project roadways, in a manner consistent with these specifications and acceptable to the Engineer.

The Contractor will not be allowed to perform any work that will interfere with traffic operations on a roadway when traffic operations are being restricted on that same roadway, unless there is at least a one mile clear area length where the entire roadway is open to traffic or the closures have been coordinated and are acceptable to the Engineer. The one mile clear area length shall be measured from the end of the first work area to the beginning of the signing pattern for the next work area.

1.08.07 - Determination of Contract Time:

Delete the second, third, and fourth paragraphs and replace with the following:

"When the Contract time is stated on a calendar-day basis, that time shall be the number of consecutive calendar days contained in the Contract period designated in the Contract, <u>INCLUDING</u> the time period from each December 1 through the following March 31. The Contract time will begin to run on the date designated in the Engineer's "Notice to Proceed" as the date for commencement of the Project, and the time will be computed as herein provided on a consecutive-day basis, including all Saturdays, Sundays, holidays, and non-work days."

1.08.08--Extension of Time:

Delete the last paragraph ("If an approved extension . . . until the following April 1.").

1.08.09--Failure to Complete Work on Time:

Delete the second paragraph ("If the last day of the initial . . . the Project is completed"), and replace with the following:

"Liquidated damages as specified in the Contract shall be assessed against the Contractor per calendar day from that day until the date on which the Project is substantially completed."

SECTION 1.20 – GENERAL CLAUSES FOR FACILITIES CONSTRUCTION

1.20-1.02.13—Knowledge of Applicable Laws:

Delete Item 6 and replace with the following:

"6. The 2011 NFPA 70 National Electrical Code, including the 2013 Connecticut Amendments."

1.20-1.03.01—Consideration of Bids:

Delete the third paragraph and replace with the following:

"The Schedule of Values shall be divided into "Line Items" listed separately for each CSI Section of the Special Provisions. An additional line item for "Mobilization" shall be incorporated into the Schedule of Values; however, this item may not exceed 7.5% of the value of the MLSI. The "Mobilization" line item will also include costs associated with "General Conditions" and "Insurance/Bonding." An additional line item for "Project Closeout" shall be incorporated into the Schedule of Values; however, this item must not be less than 2.5% of the value of the MLSI. Where requested by the Department, the Contractor shall breakdown the line items further into more specific line items."

1.20-1.08.05--Workmen and Equipment:

Add the following after the first paragraph:

"The Contractor shall install a filter with a MERV of 10 at each return air grille in the permanent HVAC system if the Engineer authorizes the use of the permanent HVAC system for temporary use during construction. The Contractor shall remove the filters prior to the Semi-Final Inspection." HPB Credit 16a-38k-3(e).

1.20-1.08.14--Acceptance of Project:

Add the following after the first sentence of subsection 2 (j):

"Include estimate of annual maintenance costs for each product included in the manual."

1.20-9.75.04—Method of Measurement:

Add the following at the end of the Section:

"Project Closeout as defined in Article 1.20-1.03.01 shall include demobilization of plant and equipment, completion of all physical work, and administrative closeout items necessary to satisfy all Contract requirements. Project Closeout will be paid in the manner described hereinafter:

1. When the non-administrative project completion requirements (as specified under Article 1.08.13) and the administrative completion requirements (as specified under Article 1.08.14) have been satisfied, 100 percent of the "Project Closeout" line item will be certified for payment."

D.B.E. SUBCONTRACTORS AND MATERIAL SUPPLIERS OR MANUFACTURERS

January 2013

I. ABBREVIATIONS AND DEFINITIONS AS USED IN THIS SPECIAL PROVISION

A. *CTDOT* means the Connecticut Department of Transportation.

B. *USDOT* means the U.S. Department of Transportation, including the Office of the Secretary, the Federal Highway Administration ("FHWA"), the Federal Transit Administration ("FTA"), and the Federal Aviation Administration ("FAA").

C. *Broker* means a party acting as an agent for others in negotiating Contracts, Agreements, purchases, sales, etc., in return for a fee or commission.

D. *Contract, Agreement or Subcontract* means a legally binding relationship obligating a seller to furnish supplies or services (including but not limited to, construction and professional services) and the buyer to pay for them. For the purposes of this provision, a lease for equipment or products is also considered to be a Contract.

E. *Contractor* means a consultant, second party or any other entity under Contract to do business with CTDOT or, as the context may require, with another Contractor.

F. *Disadvantaged Business Enterprise ("DBE")* means a for profit small business concern:

1. That is at least 51 percent owned by one or more individuals who are both socially and economically disadvantaged or, in the case of a corporation, in which 51 percent of the stock is owned by one or more such individuals; and

2. Whose management and daily business operations are controlled by one or more of the socially and economically disadvantaged individuals who own it; and

3. Certified by CTDOT under Title 49 of the Code of Federal Regulations, Part 26, (Title 49 CFR Part 23 of the Code of Federal Regulations for Participation of Disadvantaged Business Enterprise in Airport Concessions)

G. *USDOT-assisted Contract* means any Contract between CTDOT and a Contractor (at any tier) funded in whole or in part with USDOT financial assistance.

H. *Good Faith Efforts ("GFE")* means all necessary and reasonable steps to achieve a DBE goal or other requirement which by their scope, intensity, and appropriateness to the objective, can reasonably be expected to fulfill the program requirement.

I. *Small Business Concern* means, with respect to firms seeking to participate as DBEs in USDOT-assisted Contracts, a small business concern as defined pursuant to Section 3 of the Small Business Act and Small Business Administration ("SBA") regulations implementing it (13 CFR Part 121) that also does not exceed the cap on average annual gross receipts in 49 CFR Part 26, Section 26.65(b).

J. *Socially and Economically Disadvantaged Individual* means any individual who is a citizen (or lawfully admitted permanent resident) of the United States and who is:

1. Any individual who CTDOT finds, on a case-by-case basis, to be a socially and economically disadvantaged individual.

2. Any individuals in the following groups, members of which are rebuttably presumed to be socially and economically disadvantaged:

    - "Black Americans", which includes persons having origins in any of the Black racial groups of Africa;
    - "Hispanic Americans", which includes persons of Mexican, Puerto Rican, Cuban, Dominican, Central or South American, or other Spanish or Portuguese culture or origin, regardless of race;
    - "Native Americans", which includes persons who are American Indians, Eskimos, Aleuts, or Native Hawaiians.
    - "Asian-Pacific Americans", which includes persons whose origins are from Japan, China, Taiwan, Korea, Burma (Myanmar), Vietnam, Laos, Cambodia (Kampuchea), Thailand, Malaysia, Indonesia, the Philippines, Brunei, Samoa, Guam, the U.S. Trust Territories of the Pacific Islands (Republic of Palau), the Commonwealth of the Northern Marianas Islands, Macao, Fiji, Tonga, Kiribati, Juvalu, Nauru, or Federated States of Micronesia;
    - "Subcontinent Asian Americans", which includes persons whose origins are from India, Pakistan, Bangladesh, Bhutan, the Maldives Islands, Nepal or Sri Lanka;
    - Women;
    - Any additional groups whose members are designated as socially and economically disadvantaged by the SBA, at such time as the SBA designation becomes effective.

K. *Commercially Useful Function ("CUF")* means the DBE is responsible for the execution of the work of the contract and is carrying out its responsibilities by actually performing, managing, and supervising the work involved with its own forces and equipment. The DBE must be responsible for procuring, determining quantity, negotiating price, determining quality and paying for all materials (where applicable) associated with their work. The DBE must also perform at least 30% of the total cost of its contract with its own workforce.

II. ADMINISTRATIVE REQUIREMENTS

A. General Requirements

A DBE goal percentage equaling **TEN PERCENT (10%)** of the Contract value has been established for this Contract. This DBE goal percentage will be applied to the final Contract value to ultimately determine the required DBE goal. If additional work is required, DBE firms should be provided the appropriate opportunities to achieve the required DBE goal.

In order to receive credit toward the Contract DBE goal, the firms utilized as DBE subcontractors or suppliers must be certified as DBEs in the type of work to be counted for credit by CTDOT's Office of Contract Compliance prior to the date of the execution of the subcontract. Neither CTDOT nor the State of Connecticut's Unified Certification Program (UCP) makes any representation as to any DBE's technical or financial ability to perform the work. Prime contractors are solely responsible for performing due diligence in hiring DBE subcontractors.

All DBEs shall perform a CUF for the work that is assigned to them. The Contractor shall monitor and ensure that the DBE is in compliance with this requirement. The Connecticut DBE UPC Directory of certified firms can

be found on the CTDOT website http://www.ct.gov/dot. The directory lists certified DBE firms with a description of services that they are certified to perform. Only work identified in this listing may be counted towards the project's DBE goal. A DBE firm may request to have services added at any time by contacting CTDOT's Office of Contract Compliance. No credit shall be counted for any DBE firm found not to be performing a CUF.

Once a Contract is awarded, all DBEs that were listed on the pre-award DBE commitment document must be utilized. The Contractor is obligated to provide the value and items of the work originally established in the pre-award documentation to the DBE firms listed in the pre-award documentation. Any modifications to the pre-award commitment must follow the procedure established in Section II-C.

The Contractor shall designate a liaison officer who will administer the Contractor's DBE program. Upon execution of this Contract, the name of the liaison officer shall be furnished in writing to CTDOT's unit administering the Contract, CTDOT's Office of Contract Compliance and CTDOT's Office of Construction ("OOC"). Contact information for the designated liaison officer shall be furnished no later than the scheduled date for the pre-construction meeting.

The Contractor shall submit a bi-monthly report to the appropriate CTDOT unit administering the Contract. This report shall indicate what work has been performed to date, with the dollars paid and percentage of DBE goal completed.

Verified payments made to DBEs shall be included in this bi-monthly report. A sample form is included on the CTDOT website.

In addition, the report shall include:

1. A projected time frame of when the remaining work is to be completed for each DBE.

2. A statement by the Contractor either confirming that the approved DBEs are on schedule to meet the Contract goal, or that the Contractor is actively pursuing a GFE.

3. If retainage is specified in the Contract specifications, then a statement of certification that the subcontractors' retainage is being released in accordance with 1.08.01 (Revised or supplemented).

Failure by the Contractor to provide the required reports may result in CTDOT withholding an amount equal to one percent (1%) of the monthly estimate until the required documentation is received.

The Contractor shall receive DBE credit when a DBE, or any combination of DBEs, perform work under the Contract in accordance with this specification.

Only work actually performed by and/or services provided by DBEs which are certified for such work and/or services, as verified by CTDOT, can be counted toward the DBE goal. Supplies and equipment a DBE purchases or leases from the Contractor or its affiliate cannot be counted toward the goal.

Monitoring of the CUF will occur by CTDOT throughout the life of the project. If it is unclear that the DBE is performing the work specified in its subcontract with the prime Contractor, further review may be required. If it is determined that the DBE is not performing a CUF, then the work performed by that DBE will not be counted towards the DBE goal percentage.

B. Subcontract Requirements

The Contractor shall submit to CTDOT's OOC all requests for subcontractor approvals on the standard CLA-12 forms provided by CTDOT. The dollar amount and items of work identified on the CLA-12 form must, at minimum, equal the dollar value submitted in the pre-award commitment. CLA-12 forms can be found at http://www.ct.gov/dot/construction under the "Subcontractor Approval" section. All DBE subcontractors must be identified on the CLA-12 form, regardless of whether they are being utilized to meet a Contract goal percentage. A copy of the legal Contract between the Contractor and the DBE subcontractor/supplier, a copy of the Title VI Contractor Assurances and a copy of the Required Contract Provision for Federal Aid Construction Contracts (Form FHWA-1273) (Federal Highway Administration projects only) must be submitted along with a request for subcontractor approval. These attachments cannot be substituted by reference.

If retainage is specified in the Contract specifications, then the subcontract agreement must contain a prompt payment mechanism that acts in accordance with Article 1.08.01 (Revised or supplemented).

If the Contract specifications do not contain a retainage clause, the Contractor shall not include a retainage clause in any subcontract agreement, and in this case, if a Contractor does include a retainage clause, it shall be deemed unenforceable.

In addition, the following documents are to be included with the CLA-12, if applicable:

- An explanation indicating who will purchase material.
- A statement explaining any method or arrangement for utilization of the Contractor's equipment.

The subcontract must show items of work to be performed, unit prices and, if a partial item, the work involved by all parties. If the subcontract items of work or unit prices are modified, the procedure established in Section II-C must be followed.

Should a DBE subcontractor further sublet items of work assigned to it, only lower tier subcontractors who are certified as a DBE firm will be counted toward the DBE goal. If the lower tier subcontractor is a non-DBE firm, the value of the work performed by that firm will not be counted as credit toward the DBE goal.

The use of joint checks between a DBE firm and the Contractor is acceptable, provided that written approval is received from the OOC prior to the issuance of any joint check. Should it become necessary to issue a joint check between the DBE firm and the Contractor to purchase materials, the DBE firm must be responsible for negotiating the cost, determining the quality and quantity, ordering the material and installing (where applicable), and administering the payment to the supplier. The Contractor should not make payment directly to suppliers.

Each subcontract the Contractor signs with a subcontractor must contain the following assurance:

"The subcontractor/supplier/manufacturer shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor/subcontractor/supplier/manufacturer to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the recipient deems appropriate."

C. Modification to Pre-Award Commitment

Contractors may not terminate for convenience any DBE subcontractor or supplier that was listed on the pre-award DBE commitment without prior written approval of the OOC. This includes, but is not limited to, instances

in which a Contractor seeks to perform work originally designated for a DBE subcontractor with its own forces or those of an affiliate, a non-DBE firm, or with another DBE firm. Prior to approval, the Contractor must demonstrate to the satisfaction of the OOC, that it has good cause, as found in 49CFR Part 26.53 (f)(3), for termination of the DBE firm.

Before transmitting its request for approval to terminate pre-award DBE firms to the OOC, the Contractor must give written notice to the DBE subcontractor and include a copy to the OOC of its notice to terminate and/or substitute, and the reason for the notice.

The Contractor must provide five (5) days for the affected DBE firm to respond. This affords the DBE firm the opportunity to advise the OOC and the Contractor of any reasons why it objects to the termination of its subcontract and why the OOC should not approve the Contractor's action.

Once the Contract is awarded, should there be any amendments or modifications of the approved pre-award DBE submission other than termination of a DBE firm, the Contractor shall follow the procedure below that best meets the criteria associated with the reason for modification:

1. If the change is due to a scope of work revision or non-routine quantity revision by CTDOT, the Contractor must notify CTDOT's OOC in writing or via electronic mail that their DBE participation on the project may be impacted as soon as they are aware of the change. In this case, a release of work from the DBE firm may not be required; however the Contractor must concurrently notify the DBE firm in writing, and copy the OOC for inclusion in the project DBE file. This does not relieve the Contractor of its obligation to meet the Contract specified DBE goal, or of any other responsibility found in this specification.

2. If the change is due to a factor other than a CTDOT directive, a request for approval in writing or via electronic mail of the modification from the OOC must be submitted, along with an explanation of the change(s), prior to the commencement of work. The Contractor must also obtain a letter of release from the originally named DBE indicating their concurrence with the change, and the reason(s) for their inability to perform the work. In the event a release cannot be obtained, the Contractor must document all efforts made to obtain it.

3. In the event a DBE firm that was listed in the pre-award documents is **unable** or **unwilling** to perform the work assigned, the Contractor shall:

    - Notify the OOC Division Chief immediately and make efforts to obtain a release of work from the firm.

    - Submit documentation that will provide a basis for the change to the OOC for review and approval prior to the implementation of the change.

    - Use the DBE Directory to identify and contact firms certified to perform the type of work that was assigned to the unable or unwilling DBE firm. The Contractor should also contact CTDOT's Office of Contract Compliance for assistance in locating additional DBE firms to the extent needed to meet the contract goal.

Should a DBE subcontractor be terminated or fail to complete work on the Contract for any reason, the Contractor must make a GFE to find another DBE subcontractor to substitute for the original DBE. The DBE replacement shall be given every opportunity to perform at least the same amount of work under the Contract as the original DBE subcontractor.

If the Contractor is unable to find a DBE replacement:

- The Contractor should identify other contracting opportunities and solicit DBE firms in an effort to meet the Contract DBE goal requirement, if necessary, and provide documentation to support a GFE. (Refer to GFE in Section III.)

- The Contractor must demonstrate that the originally named DBE, who is unable or unwilling to perform the work assigned, is in default of its subcontract, or identify other issues that affected the DBE firm's ability to perform the assigned work. **The Contractor's ability to negotiate a more advantageous agreement with another subcontractor is not a valid basis for change.**

III. GOOD FAITH EFFORTS

The DBE goal is **NOT** reduced or waived for projects where the Contractor receives a Pre-Award GFE determination from the Office of Contract Compliance prior to the award of the Contract. It remains the responsibility of the Contractor to make a continuing GFE to achieve the specified Contract DBE goal. The Contractor shall pursue every available opportunity to obtain additional DBE firms and document all efforts made in such attempts.

At the completion of all Contract work, the Contractor shall submit a final report to CTDOT`s unit administering the Contract indicating the work done by and the dollars paid to DBEs. Only verified payments made to DBEs performing a CUF will be counted towards the Contract goal.

Goal attainment is based on the total Contract value, which includes all construction orders created during the Contract. If the Contractor does not achieve the specified Contract goal for DBE participation or has not provided the value of work to the DBE firms originally committed to in the pre-award submission, the Contractor shall submit documentation to CTDOT`s unit administering the Contract detailing the GFE made during the performance of the Contract to satisfy the goal.

A GFE should consist of the following, where applicable (CTDOT reserves the right to request additional information):

1. A detailed statement of the efforts made to replace an unable or unwilling DBE firm, and a description of any additional subcontracting opportunities that were identified and offered to DBE firms in order to increase the likelihood of achieving the stated goal.

2. A detailed statement, including documentation of the efforts made to contact and solicit bids from certified DBEs, including the names, addresses, and telephone numbers of each DBE firm contacted; the date of contact and a description of the information provided to each DBE regarding the scope of services and anticipated time schedule of work items proposed to be subcontracted and the response from firms contacted.

3. Provide a detailed explanation for each DBE that submitted a subcontract proposal which the Contractor considered to be unacceptable stating the reason(s) for this conclusion.

4. Provide documentation, if any, to support contacts made with CTDOT requesting assistance in satisfying the specified Contract goal.

5. Provide documentation of all other efforts undertaken by the Contractor to meet the defined goal. Additional documentation of efforts made to obtain DBE firms may include but will not be limited to:
   - Negotiations held in good faith with interested DBE firms, not rejecting them without sound reasons.
   - Written notice provided to a reasonable number of specific DBE firms in sufficient time to allow effective participation.
   - Those portions of work that could be performed by readily available DBE firms.

In instances where the Contractor can adequately document or substantiate its GFE and compliance with other DBE Program requirements, the Contractor will have satisfied the DBE requirement and no administrative remedies will be imposed.

IV. PROJECT COMPLETION

At the completion of all Contract work, the Contractor shall:

1. Submit a final report to CTDOT`s unit administering the Contract indicating the work done by, and the dollars paid to DBEs.

2. Submit verified payments made to all DBE subcontractors for the work that was completed.

3. Submit documentation detailing any changes to the DBE pre-award subcontractors that have not met the original DBE pre-award commitment, including copies of the Department's approvals of those changes.

4. Retain all records for a period of three (3) years following acceptance by CTDOT of the Contract and those records shall be available at reasonable times and places for inspection by authorized representatives of CTDOT and Federal agencies. If any litigation, claim, or audit is started before the expiration of the three (3) year period, the records shall be retained until all litigation, claims, or audit findings involving the records are resolved.

If the Contractor does not achieve the specified Contract goal for DBE participation in addition to meeting the dollar value committed to the DBE subcontractors identified in the pre-award commitment, the Contractor shall submit documentation to CTDOT`s unit administering the Contract detailing the GFE made during the performance of the Contract to satisfy the goal.

V. SHORTFALLS

A. Failure to meet DBE goals

As specified in (II-A) above, attainment of the Contract DBE goal is based on the final Contract value. The Contractor is expected to achieve the amount of DBE participation originally committed to at the time of award; however, additional efforts must be made to provide opportunities to DBE firms in the event a Contract's original value is increased during the life of the Contract.

The Contractor is expected to utilize the DBE subcontractors originally committed in the DBE pre-award documentation for the work and dollar value that was originally assigned.

If a DBE is terminated or is unable or unwilling to complete its work on a Contract, the Contractor shall make a GFE to replace that DBE with another certified DBE to meet the Contract goal.

The Contractor shall immediately notify the OOC of the DBE's inability or unwillingness to perform, and provide reasonable documentation and make efforts to obtain a release of work from the firm.

If the Contractor is unable to find a DBE replacement, then the Contractor should identify other contracting opportunities and solicit DBE firms in an effort to meet the Contract DBE goal requirement, if necessary, and provide documentation to support a GFE.

When a DBE is unable or unwilling to perform, or is terminated for just cause, the Contractor shall make a GFE to find other DBE opportunities to increase DBE participation to the extent necessary to at least satisfy the Contract goal.

For any DBE pre-award subcontractor that has been released appropriately from the project, no remedy will be assessed, provided that the Contractor has met the criteria described in Section II-C.

B. Administrative Remedies for Non-Compliance:

In cases where the Contractor has failed to meet the Contract specified DBE goal or the DBE pre-award commitment, and where no GFE has been demonstrated, then one or more of the following administrative remedies will be applied:

1. A reduction in Contract payments to the Contractor as determined by CTDOT, not to exceed the shortfall amount of the **DBE goal**. The maximum shortfall will be calculated by multiplying the Contract DBE goal (adjusted by any applicable GFE) by the final Contract value, and subtracting any verified final payments made to DBE firms by the Contractor.

2. A reduction in Contract payments to the Contractor determined by CTDOT, not to exceed the shortfall amount of the **pre-award commitment**. The maximum shortfall will be calculated by subtracting any verified final payments made by the Contractor to each DBE subcontractor from the amount originally committed to that subcontractor in the pre-award commitment.

3. A reduction in Contract payments to the Contractor determined by CTDOT for any pre-award DBE subcontractor who has not obtained the dollar value of work identified in the DBE pre-award commitment and has not followed the requirements of Section II-C or for any DBE firm submitted for DBE credit that has not performed a CUF.

4. The Contractor being required to submit a written DBE Program Corrective Action Plan to CTDOT for review and approval, which is aimed at ensuring compliance on future projects.

5. The Contractor being required to attend a Non-Responsibility Meeting on the next contract where it is the apparent low bidder.

6. The Contractor being suspended from bidding on contracts for a period not to exceed six (6) months.

VI. CLASSIFICATIONS OTHER THAN SUBCONTRACTORS

A. Material Manufacturers

Credit for DBE manufacturers is 100% of the value of the manufactured product. A manufacturer is a firm that operates or maintains a factory or establishment that produces on the premises the materials or supplies obtained by the Contractor.

If the Contractor elects to utilize a DBE manufacturer to satisfy a portion of, or the entire specified DBE goal, the Contractor must provide the OOC with:

- Subcontractor Approval Form (CLA-12) indicating the firm designation,
- An executed "Affidavit for the Utilization of Material Suppliers or Manufacturers" (sample attached), and
- Substantiation of payments made to the supplier or manufacturer for materials used on the project.

B. Material Suppliers (Dealers)

Credit for DBE dealers/suppliers is limited to 60% of the value of the material to be supplied, provided such material is obtained from an approved DBE dealer/supplier.

In order for a firm to be considered a regular dealer, the firm must own, operate, or maintain a store, warehouse, or other establishment in which the materials, supplies, articles or equipment of the general character described by the specifications and required under the contract are bought, kept in stock, and regularly sold or leased to the public in the usual course of business. At least one of the following criteria must apply:

- To be a regular dealer, the firm must be an established, regular business that engages, as its principal business and under its own name, in the purchase and sale or lease of the products in question.
- A person may be a regular dealer in such bulk items as petroleum products, steel, cement, gravel, stone, or asphalt without owning, operating or maintaining a place of business if the person both owns and operates distribution equipment for the products. Any supplementing of the regular dealers' own distribution equipment shall be by long term lease agreement, and not on an ad hoc or contract to contract basis.
- Packagers, brokers, manufacturers' representatives, or other persons who arrange or expedite transactions are not regular dealers within the meaning of this paragraph.

If the Contractor elects to utilize a DBE supplier to satisfy a portion or the entire specified DBE goal, the Contractor must provide the OOC with:

- Subcontractor Approval Form (CLA-12) indicating the firm designation,
- An executed "Affidavit for the Utilization of Material Suppliers or Manufacturers" (sample attached), and
- Substantiation of payments made to the supplier or manufacturer for materials used on the project.

C. Brokering

- Brokering of work for DBE firms who have been listed by the Department as certified brokers is allowed. Credit for those firms shall be applied following the procedures in Section VI-D.

- Brokering of work by DBEs who have been approved to perform subcontract work with their own workforce and equipment is not allowed, and is a Contract violation.

- Firms involved in the brokering of work, whether they are DBEs and/or majority firms who engage in willful falsification, distortion or misrepresentation with respect to any facts related to the project shall be referred to the U.S. DOT, Office of the Inspector General for prosecution under Title 18, U.S. Code, Part I, Chapter 47, Section 1020.

D. Non-Manufacturing or Non-Supplier DBE Credit

Contractors may count towards their DBE goals the following expenditures with DBEs that are not manufacturers or suppliers:

- Reasonable fees or commissions charged for providing a bona fide service such as professional, technical, consultant or managerial services and assistance in the procurement of essential personnel, facilities, equipment materials or supplies necessary for the performance of the Contract, provided that the fee or commission is determined by the OOC to be reasonable and consistent with fees customarily allowed for similar services.

- The fees charged only for delivery of materials and supplies required on a job site when the hauler, trucker, or delivery service is a DBE, and not the manufacturer, or regular dealer of the materials and supplies, and provided that the fees are determined by the OOC to be reasonable and not excessive as compared with fees customarily allowed for similar services.

- The fees or commissions charged for providing bonds or insurance specifically required for the performance of the Contract, provided that the fees or commissions are determined by CTDOT to be reasonable and not excessive as compared with fees customarily allowed for similar services.

E. Trucking

While technically still considered a subcontractor, the rules for counting credit for DBE trucking firms are as follows:

- The DBE must own and operate at least one fully licensed, insured, and operational truck used on the Contract.
- The DBE receives credit for the total value of the transportation services it provides on the Contract using trucks it owns, insures and operates using drivers it employs.
- The DBE may lease trucks from another DBE firm, including an owner-operator who is certified as a DBE. The DBE who leases trucks from another DBE receives credit for the total value of the transportation services the lessee DBE provides on the Contract.
- The DBE may lease trucks from a non-DBE firm; however the DBE may only receive credit for any fees or commissions received for arranging transportation services provided by the non-DBE firms. Additionally, the DBE firm must demonstrate that they are in full control of the trucking operation for which they are seeking credit.

VII. Suspected DBE Fraud

In appropriate cases, CTDOT will bring to the attention of the USDOT any appearance of false, fraudulent, or dishonest conduct in connection with the DBE program, so that USDOT can take the steps, e.g. referral to the

Department of Justice for criminal prosecution, referral to USDOT Inspector General, action under suspension and debarment or Program Fraud and Civil Penalties rules provided in 49 CFR Part 31.

CONNECTICUT DEPARTMENT OF TRANSPORTATION
(OFFICE OF CONSTRUCTION)
BUREAU OF ENGINEERING AND CONSTRUCTION

This affidavit must be completed by the State Contractor's DBE notarized and attached to the contractor's request to utilize a DBE supplier or manufacturer as a credit towards its DBE contract requirements; failure to do so will result in not receiving credit towards the contract DBE requirement.

State Contract No.

Federal Aid Project No.

Description of Project

I, _____, acting in behalf of _____,
(Name of person signing Affidavit) (DBE person, firm, association or corporation)
of which I am the _____ certify and affirm that _____
(Title of Person) (DBE person, firm, association or corporation)
is a certified Connecticut Department of Transportation DBE. I further certify and affirm that I have read and understand 49 CFR, Sec. 26.55(e)(2), as the same may be revised.

I further certify and affirm that _____ will assume the actual and
(DBE person, firm, association or Corporation)
for the provision of the materials and/or supplies sought by _____ .

If a manufacturer, I operate or maintain a factory or establishment that produces, on the premises, the materials, supplies, articles or equipment required under the contract an of the general character described by the specifications.

If a supplier, I perform a commercially useful function in the supply process. As a regular dealer, I, at a minimum, own and operate the distribution equipment for bulk items. Any supplementing of my distribution equipment shall be by long-term lease agreement, and not on an ad hoc or contract-by-contract basis.

I understand that false statements made herein are punishable by Law (Sec. 53a-157), CGS, as revised).

(Name of Corporation or Firm)

(Signature & Title of Official making the Affidavit)

Subscribed and sworn to before me, this _____ day of _____ 20 _____.

Notary Public (Commissioner of the Superior Court)

My Commission Expires_____

CERTIFICATE OF CORPORATION

I, _____, certify that I am the _____
(Official) (President)
of the Corporation named in the foregoing instrument; that I have been duly authorized to affix the seal of the Corporation to such papers as require the seal; that _____, who signed said instrument on behalf of the Corporation, was then _____ of said corporation; that said instrument was duly signed for and in behalf of said Corporation by authority of its governing body and is within the scope of its corporation powers.

_____ _____
(Signature of Person Certifying) (Date)

ITEM #0100150A - MAINTENANCE FACILITY

Description: Under this item, the Contractor shall complete all work depicted on the Contract Plans and described in the CSI-formatted Specifications that make up this Major Lump Sum Item (MLSI). Refer to Form 816 Article 1.20-1.02.04 for additional information in this regard.

Any work incidental to another bid item which is not specifically described or included in the bid item, but which is required for performance and completion of the work required under the Contract, shall be considered to be included under this item.

Materials: All materials shall be as required by the Contract Plans and as described in the CSI-formatted Specifications that make up this MLSI.

Construction Methods: All methods of construction shall conform to the requirements as stipulated in the CSI-formatted Specifications that make up this MLSI.

Method of Measurement: This item will be paid for at the contract lump sum price for "Item No. 0100150A – Maintenance Facility" complete.

Basis of Payment: This item will be paid for at the contract lump sum price for "Item No. 0100150A – Maintenance Facility", which price shall include all administrative and procedural requirements, material, equipment, labor, and work incidental thereto.

PAY ITEM	PAY UNIT
"Item No. 0100150A – Maintenance Facility"	LS

ITEM #0100151A – WATER AND WASTEWATER FACILITIES

Description: Under this item, the Contractor shall complete all work depicted on the Contract Plans and described in the CSI-formatted Specifications that make up this Major Lump Sum Item (MLSI). Refer to Form 816 Article 1.20-1.02.04 for additional information in this regard.

Any work incidental to another bid item which is not specifically described or included in the bid item, but which is required for performance and completion of the work required under the Contract, shall be considered to be included under this item.

Materials: All materials shall be as required by the Contract Plans and as described in the CSI-formatted Specifications that make up this MLSI.

Construction Methods: All methods of construction shall conform to the requirements as stipulated in the CSI-formatted Specifications that make up this MLSI.

Method of Measurement: This item will be paid for at the contract lump sum price for "Item No. 0100151A – Water and Wastewater Facilities" complete.

Basis of Payment: This item will be paid for at the contract lump sum price for "Item No. 0100151A – Water and Wastewater Facilities", which price shall include all administrative and procedural requirements, material, equipment, labor, and work incidental thereto.

PAY ITEM	PAY UNIT
"Item No. 01000151A – Water and Wastewater Facilities"	LS

ITEM #0100500A - CONSTRUCTION COMMUNICATION EQUIPMENT

Description:

Under this item, the Contractor shall provide:

1. Communication equipment for use by the ConnDOT forces. This item shall include all necessary equipment, accessories, material and labor to put the system into operation. Provisions shall also be made to maintain all provided communication equipment and any additional communication equipment assigned to the project, as directed by the Engineer.

2. A toll-free, reservation-less telephone conference call account for the use of the Engineer.

Materials: Materials, supplies and equipment shall be in like new condition as approved by the Engineer. The following shall be provided:

QTY	Description:
10	Windows Tablets as specified below under Computer Hardware and Software. All supplies, maintenance and wireless service plans shall be provided by the Contractor.
TBD – See Const. Methods	A hand held cellular phone which shall include all necessary equipment, accessories (including but not limited to car charger and holster), materials, labor and maintenance to make the system operational. In addition, the phones shall have voice mail, caller ID and call waiting.

Any supplies required to maintain or operate the equipment above listed above shall be provided by the Contractor for the duration of the project at no additional charge.

Once the Contract has been completed, the computer will remain the property of the Contractor. Prior to the return of any computer(s) to the Contractor, field personnel will coordinate the removal of Department owned equipment, software, data, and associated equipment.

Computer Hardware and Software:

The computer system furnished shall have all software and hardware necessary for the complete installation of the latest versions of the software listed, and therefore supplements the minimum specifications below.

The Contractor shall provide the Engineer with a licensed copy registered in the Department's name of the latest versions of the software listed and maintain customer support services offered by each software producer for the duration of the Contract. The Contractor shall deliver to the Engineer all supporting documentation for the software and hardware including any instructions or manuals.

The Contractor shall provide the computer system with all required supplies, maintenance and repairs (including labor and parts) throughout the Contract life.

(A) Windows Tablet – Minimum Specification:

Nokia Lumia 2520 Tablet or equivalent.
Processor – Qualcomm Snapdragon™ 800, quad-core 2.2 GHz.
Memory – 2 GB.
Screen – 10.1 inch, full HD, wide angle view LCD, gorilla glass, touch display.
Hard Drive – 32 GB solid state hard drive.
Multimedia Package – Integrated front and rear cameras, microphone and speaker.
Wireless Network Adapters – Intel a/b/g/n, Bluetooth, and 4G Broadband Cellular (including month to month data service plan (min 4GB/ mo) on the Verizon or AT&T networks).
External Memory Slot – SD / micro SD with a 32 GB memory card.
Power adapters – One (1) AC wall adapter and One (1) 12 Volt DC Auto adapter.
Stylus – One (1) stylus compatible with touch screen.
Operating System – Windows 8.1 RT, latest available Service Pack.
Application Software – MS Office 2013 Outlook, Word, Excel and OneNote.
Multi-function Cover and Keyboard – Nokia Multi-function Cover and Keyboard.
Protective Carrying Case – Carrying case sized to carry tablet and accessories.
Warranty & Service Plan – 1 year onsite.

Note: Before ordering the computer hardware and software, the Contractor must submit a copy of their proposed PC specifications to the ConnDOT Project Engineer for review. If the specification meets or exceeds the listed minimum specifications, then the Contractor will be notified that the order may be placed.

Arrangements must be made a minimum of 24 hours in advance of delivery of computer equipment to the District Office. Arrangements should be made by contacting the ConnDOT Project Engineer. All software, hardware and licenses listed below shall be clearly labeled, specifying the (1) Project Number, (2) Contractor Name, (3) Project Engineer's Name and (4) Project Engineer's Phone Number.

Construction Methods:

<u>Tablets/PCs</u>

Before ordering the computer hardware and software, the Contractor must submit a copy of their proposed PC specifications to the ConnDOT Project Engineer for review. If the specification meets or exceeds the listed minimum specifications, then the Contractor will be notified that the order may be placed.

Arrangements must be made a minimum of 24 hours in advance of delivery of equipment to the District Office. Arrangements should be made by contacting the ConnDOT Project Engineer. All software, hardware and licenses listed below shall be clearly labeled, specifying the (1) Project Number, (2) Contractor Name, (3) Project Engineer's Name and (4) Project Engineer's Phone Number.

Telephone Communication Equipment:

The Contractor shall submit three (3) proposals for both the communication equipment described herein and forward to the Engineer for approval. The Department will provide the Contractor with the estimated quantity of phones required for inspection personnel.

The three proposals may be for either rental or purchase of equipment that is new or of like-new condition and meeting the specification requirements. Also, the three proposals must indicate the minimum and maximum number of phones that will be allotted. The Engineer will have ten (10) days from receipt of the proposals to inform the Contractor of its selection. Once approved, the contractor shall order the equipment, and have it installed and operating within fifteen (15) working days.

The Contractor will furnish to the State, a copy of the monthly call record for each phone when submitting the billing invoices for the communication equipment.

All equipment and associated materials will remain the property of the Contractor upon completion of the project unless otherwise specified by the Engineer in writing.

Telephone Conference Call Account: The Contractor shall submit three (3) proposals for the telephone conference call account described herein and forward to the Engineer for approval.

The Engineer will have ten (10) days from receipt of the proposals to inform the Contractor of its selection. Once approved, the contractor shall activate the account within five (5) working days.

Once activated, the Engineer will act as the "moderator" and control all associated PIN numbers.

The Contractor will furnish to the State, a copy of the detailed monthly account history when submitting the billing invoices for the telephone conference call account.

Method of Measurement: The item, Construction Communication Equipment, will be measured for payment based on actual detailed invoices.

Basis of Payment: The sum of money shown on the Estimate and in the itemized proposal as "Estimated Cost" for this work will be considered the bid price even though payment will be made as described below. The estimated cost figure is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figures will be disregarded and the original price will be used to determine the total amount for the contract.

The item, "Construction Communication Equipment", will be paid for at the actual detailed monthly account history for services approved by the Engineer, plus a 5% markup.

Payment will include all materials, equipment, labor and maintenance associated with this item.

Pay Item	Pay Unit
Construction Communication Equipment (Estimated Cost)	est.

ITEM #0101000A - ENVIRONMENTAL HEALTH AND SAFETY

Description:

Under this item, the Contractor shall establish protocols and provide procedures to protect the health and safety of its employees and subcontractors as related to the proposed construction activities performed within the Project AOECs. Work under this Item consists of the development and implementation of a written HASP that addresses the relative risk of exposure to documented hazards present within Project limits. The HASP shall establish health and safety protocols that address the relative risk of exposure to regulated substances in accordance with 29 CFR 1910.120 and 29 CFR 1926.65. Such protocols shall only address those concerns directly related to site conditions.

Note: The Engineer will prepare a site-specific health and safety plan which is compatible with the Contractor's plan and will be responsible for the health and safety of all Project Inspectors, Department employees and consulting engineers.

Materials:

The Contractor must provide chemical protective clothing (CPC) and personal protective equipment (PPE) as stipulated in the Contractor's HASP during the performance of work in areas identified as potentially posing a risk to worker health and safety for workers employed by the Contractor and all subcontractors.

Construction Methods:

1-Existing Information: The Contractor shall utilize all available information and existing records and data pertaining to chemical and physical hazards associated with any of the regulated substances identified in the environmental site investigations to develop the HASP. A list of documents containing this data is found in "Notice to Contractor – Environmental Investigations".

2-General: The requirements set forth herein pertain to the provision of workers' health and safety as it relates to proposed Project activities when performed in the presence of hazardous or regulated materials or otherwise environmentally sensitive conditions. THE PROVISION OF WORKER HEALTH AND SAFETY PROTOCOLS WHICH ADDRESS POTENTIAL AND/OR ACTUAL RISK OF EXPOSURE TO SITE SPECIFIC HAZARDS POSED TO CONTRACTOR EMPLOYEES IS SOLELY THE RESPONSIBILITY OF THE CONTRACTOR.

The Contractor shall be responsible for the development, implementation and oversight of the HASP throughout the performance of work within the limits of the AOEC, as identified in the Contract Documents, and in other areas identified by the Engineer or by the HASP where site conditions may pose a risk to worker health and safety and/or the environment. **No physical**

aspects of the work within the AOECs shall begin until the HASP is reviewed by the Engineer and is determined to meet the requirements of the specifications. However, the Contract time, in accordance with Article 1.03.08, will begin on the date stipulated in the Notice to Proceed.

3-Regulatory Requirements: All construction related activities performed by the Contractor within the limits of the AOECs or in other areas where site conditions may pose a risk to worker health and safety and/or the environment shall be performed in conformance with 29 CFR 1926, Safety and Health Regulations for Construction and 29 CFR 1910, Safety and Health Regulations for General Industry. Conformance to 29 CFR 1910.120, Hazardous Waste Site Operations and Emergency Response (HAZWOPER) may also be required, where appropriate.

4-Submittals: Three copies of the HASP shall be submitted to the Engineer within four (4) weeks after the Award of Contract or four (4) weeks prior to the start of any work in the AOEC, whichever is first, but not before the Award of the Contract.

The HASP shall be developed by a qualified person designated by the Contractor. This qualified person shall be a Certified Industrial Hygienist (CIH), Certified Hazardous Material Manager (CHMM), or a Certified Safety Professional (CSP). He/she shall have review and approval authority over the HASP and be identified as the Health and Safety Manager (HSM). The HASP shall bear the signature of said HSM indicating that the HASP meets the minimum requirements of 29 CFR 1910.120 and 29 CFR 1926.65.

The Engineer will review the HASP within four (4) weeks of submittal and provide written comments as to deficiencies in and/or exceptions to the plan(s), if any, to assure consistency with the specifications, applicable standards, policies and practices and appropriateness given potential or known site conditions. Items identified in the HASP which do not conform to the specifications will be brought to the attention of the Contractor, and the Contractor shall revise the HASP to correct the deficiencies and resubmit it to the Engineer for determination of compliance with this item. The Contractor shall not be allowed to commence work activities in the AOEC‘s, as shown on the Plans, or where site conditions exist which may pose a risk to worker health and safety and/or the environment, until the HASP has been reviewed and accepted by the Engineer. No claim for delay in the progress of work will be considered for the Contractor’s failure to submit a HASP that conforms to the requirements of the Contract.

5-HASP Provisions:

(a) General Requirements: The Contractor shall prepare a HASP covering all Project site work regulated by 29 CFR 1910.120(b)/ 1926.65(b) to be performed by the Contractor and all subcontractors under this Contract. The HASP shall establish in detail, the protocols necessary for the recognition, evaluation, and control of all hazards associated with each task performed under this Contract. The HASP shall address site-specific safety and health hazards of each phase of site operation and include the requirements and procedures for employee protection. The level of detail provided in the HASP shall be tailored to the type of work, complexity of operations to be performed, and hazards

anticipated. Details about some activities may not be available when the initial HASP is prepared and submitted. Therefore, the HASP shall address, in as much detail as possible, all anticipated tasks, their related hazards and anticipated control measures.

The HASP shall interface with the Contractor's Safety and Health Program. Any portions of the Safety and Health Program that are referenced in the HASP shall be included as appendices to the HASP. All topics regulated by the 29 CFR 1910.120(b)(4) and those listed below shall be addressed in the HASP. Where the use of a specific topic is not applicable to the Project, the HASP shall include a statement to justify its omission or reduced level of detail and establish that adequate consideration was given the topic.

(b) Elements:

(i) Site Description and Contamination Characterization: The Contractor shall provide a site description and contaminant characterization in the HASP that meets the requirements of 29 CFR 1910.120/1926.65.

(ii) Safety and Health Risk Analysis/Activity Hazard Analysis: The HASP shall address the safety and health hazards on this site for every operation to be performed. The Contractor shall review existing records and data to identify potential chemical and physical hazards associated with the site and shall evaluate their impact on field operations. Sources, concentrations (if known), potential exposure pathways, and other factors as noted in CFR 1910.120/126.65, paragraph (c)(7) employed to assess risk shall be described. The Contractor shall develop and justify action levels for implementation of engineering controls and personal protective equipment upgrades and downgrades for controlling worker exposure to the identified hazards. If there is no permissible exposure limit (PEL) or published exposure level for an identified hazard, available information from other published studies may be used as guidance. Any modification of an established PEL must be fully documented.

The HASP shall include a comprehensive section that discusses the tasks and objectives of the site operations and logistics and resources required to complete each task. The hazards associated with each task shall be identified. Hazard prevention techniques, procedures and/or equipment shall be identified to mitigate each of the hazards identified.

(iii) Staff Organization, Qualifications and Responsibilities: The HASP shall include a list of personnel expected to be engaged in site activities and certify that said personnel have completed the educational requirements stipulated in 29 CFR 1910.120 and 29 CFR 1926.65, are currently monitored under a medical surveillance program in compliance with those regulations, and that they are fit for work under "level C" conditions.

The Contractor shall assign responsibilities for safety activities and procedures. An outline or flow chart of the safety chain of command shall be provided in the HASP. Qualifications, including education, experience, certifications, and training in safety and health for all personnel engaged in safety and health functions shall be documented in the

HASP. Specific duties of each on-site team member should be identified. Typical team members include but are not limited to Team Leader, Scientific Advisor, Site Safety Officer, Public Information Officer, Security Officer, Record Keeper, Financial Officer, Field Team Leader, and Field Team members.

The HASP shall also include the name and qualifications of the individual proposed to serve as Health and Safety Officer (HSO). The HSO shall have full authority to carry out and ensure compliance with the HASP. The Contractor shall provide a competent HSO on-site who is capable of identifying existing and potential hazards in the surroundings or working conditions which are unsanitary, hazardous or dangerous to employees and who has authorization to take prompt corrective measures to eliminate or control them. The qualifications of the HSO shall include completion of OSHA 40-hour HAZWOPER training and 8-hour HAZWOPER supervisory training; a minimum of one year of working experience with the regulated compounds that have been documented to exist within Project limits; a working knowledge of Federal and State safety regulations; specialized training or documented experience (one year minimum) in personal and respiratory protective equipment program implementation; the proper use of air monitoring instruments, air sampling methods and procedures; and certification training in first aid and CPR by a recognized, approved organization such as the American Red Cross.

The primary duties of the HSO shall be those associated with worker health and safety. The Contractor's HSO responsibilities shall be detailed in the written HASP and shall include, but not be limited to the following:

(A) Directing and implementing the HASP.

(B) Ensuring that all Project personnel have been adequately trained in the recognition and avoidance of unsafe conditions and the regulations applicable to the work environment to control or eliminate any hazards or other exposure to illness or injury (29 CFR 1926.21). All personnel shall be adequately trained in procedures outlined in the Contractor's written HASP.

(C) Authorizing Stop Work Orders, which shall be executed upon the determination of an imminent health and safety concern.

(D) Contacting the Contractor's HSM and the Engineer immediately upon the issuance of a Stop Work order when the HSO has made the determination of an imminent health and safety concern.

(E) Authorizing work to resume, upon approval from the Contractor's HSM.

(F) Directing activities, as defined in the Contractor's written HASP, during emergency situations; and

(G) Providing personal monitoring where applicable, and as identified in the HASP.

(iv) Employee Training Assignments: The Contractor shall develop a training program to inform employees, supplier's representatives, and official visitors of the special hazards and procedures (including PPE, its uses and inspections) to control these hazards during field operations. Official visitors include but are not limited to Federal Agency Representatives, State Agency Representatives, Municipal Agency Representatives, Contractors, subcontractors, etc. This program shall be consistent with the requirements of 29 CFR 1910.120 and 29 CFR 1926.65.

(v) Personal Protective Equipment: The plan shall include the requirements and procedures for employee protection and should include a detailed section on respiratory protection. The Contractor shall describe in detail and provide appropriate personal protective equipment (PPE) to insure that workers are not exposed to levels greater than the action level for identified hazards for each operation stated for each work zone. The level of protection shall be specific for each operation and shall be in compliance with all requirements of 29 CFR 1910 and 29 CFR 1926. The Contractor shall provide, maintain, and properly dispose of all PPE.

(vi) Medical Surveillance Program: All on-site Contractor personnel engaged in 29 CFR 1910.120/1926.65 operations shall have medical examinations meeting the requirements of 29 CFR 1910.120(f) prior to commencement of work.

The HASP shall include certification of medical evaluation and clearance by the physician for each employee engaged in 29 CFR 1910.120/1926.65 operations at the site.

(vii) Exposure Monitoring/Air Sampling Program: The Contractor shall submit an Air Monitoring Plan as part of the HASP which is consistent with 29 CFR 1910.120, paragraphs (b)(4)(ii)(E), (c)(6), and (h). The Contractor shall identify specific air sampling equipment, locations, and frequencies in the air-monitoring plan. Air and exposure monitoring requirements shall be specified in the Contractor's HASP. The Contractor's CIH shall specify exposure monitoring/air sampling requirements after a careful review of the contaminants of concern and planned site activities.

(viii) Site Layout and Control: The HASP shall include a map, work zone delineation (support, contamination, reduction and exclusion), on/off-site communications, site access controls, and security (physical and procedural).

(ix) Communications: Written procedures for routine and emergency communications procedures shall be included in the Contractor's HASP.

(x) Personal Hygiene, Personal Decontamination and Equipment Decontamination: Decontamination facilities and procedures for personnel protective equipment, sampling equipment, and heavy equipment shall be discussed in detail in the HASP.

(xi) Emergency Equipment and First Aid Requirements: The Contractor shall provide appropriate emergency first aid kits and equipment suitable to treat exposure to the hazards identified, including chemical agents. The Contractor will provide personnel that have certified first aid/CPR training on-site at all times during site operations.

(xii) Emergency Response Plan and Spill Containment Program: The Contractor shall establish procedures in order to take emergency action in the event of immediate hazards (i.e., a chemical agent leak or spill, fire or personal injury). Personnel and facilities supplying support in emergency procedures will be identified. The emergency equipment to be present on-site and the Emergency Response Plan procedures, as required 29 CFR 1910.120, paragraph (1)(1)(ii) shall be specified in the Emergency Response Plan. The Emergency Response Plan shall be included as part of the HASP. This Emergency Response Plan shall include written directions to the closest hospital as well as a map showing the route to the hospital.

(xiii) Logs, Reports and Record Keeping: The Contractor shall maintain safety inspections, logs, and reports, accident/incident reports, medical certifications, training logs, monitoring results, etc. All exposure and medical monitoring records are to be maintained according to 29 CFR 1910 and 29 CFR 1926. The format of these logs and reports shall be developed by the Contractor to include training logs, daily logs, weekly reports, safety meetings, medical surveillance records, and a phase-out report. These logs, records, and reports shall be maintained by the Contractor and be made available to the Engineer.

The Contractor shall immediately notify the Engineer of any accident/ incident. Within two working days of any reportable accident, the Contractor shall complete and submit to the Engineer an accident report.

(xiv) Confined space entry procedures: Confined space entry procedures, both permit required and non permit required, shall be discussed in detail.

(xv) Pre-entry briefings: The HASP shall provide for pre-entry briefings to be held prior to initiating any site activity and at such other times as necessary to ensure that employees are apprised of the HASP and that this plan in being followed.

(xvi) Inspections/audits: The HSM or HSO shall conduct Inspections or audits to determine the effectiveness of the HASP. The Contractor shall correct any deficiencies in the effectiveness of the HASP.

6-HASP Implementation: The Contractor shall implement and maintain the HASP throughout the performance of work. In areas identified as having a potential risk to worker health and safety, and in any other areas deemed appropriate by the HSO, the Contractor shall be prepared to immediately implement the appropriate health and safety measures, including but not limited to the use of personal protective equipment (PPE), and engineering and administrative controls.

If the Engineer observes deficiencies in the Contractor's operations with respect to the HASP, they shall be assembled in a written field directive and given to the Contractor. The Contractor shall immediately correct the deficiencies and respond, in writing, as to how each was corrected. Failure to bring the work area(s) and implementation procedures into compliance will result in a Stop Work Order and a written directive to discuss an appropriate resolution(s) to the matter. When the Contractor demonstrates compliance, the Engineer shall remove the Stop Work Order. If a Stop Work Order has been issued for cause, no delay claims on the part of the Contractor will be honored.

Disposable CPC/PPE, i.e. disposable coveralls, gloves, etc., which come in direct contact with hazardous or potentially hazardous material shall be placed into 55 gallon USDOT 17-H drums and disposed of in accordance with Federal, State, and local regulations. The drums shall be temporarily staged and secured within the WSA until the material is appropriately disposed.

7-HASP Revisions: The HASP shall be maintained on-site by the Contractor and shall be kept current with construction activities and site conditions under this Contract. The HASP shall be recognized as a flexible document which shall be subject to revisions and amendments, as required, in response to actual site conditions, changes in work methods and/or alterations in the relative risk present. All changes and modifications shall be signed by the Contractor's HSM and shall require the review and acceptance by the Engineer prior to the implementation of such changes.

Should any unforeseen hazard become evident during the performance of the work, the HSO shall bring such hazard to the attention of the Contractor and the Engineer as soon as possible. In the interim, the Contractor shall take action, including Stop Work Orders and/or upgrading PPE as necessary to re-establish and maintain safe working conditions and to safeguard on-site personnel, visitors, the public and the environment. The HASP shall then be revised/amended to reflect the changed condition.

Method of Measurement:

1-Within thirty (30) calendar days of the award of the Contract, the Contractor shall submit to the Engineer for acceptance a breakdown of its lump sum bid price for this item detailing:

(a) The development costs associated with preparing the HASP in accordance with these Specifications.
(b) The cost per month for the duration of the Project to implement the HASP and provide the services of the HSM and the HSO.

2-If the lump sum bid price breakdown is unacceptable to the Engineer; substantiation showing that the submitted costs are reasonable shall be required.

3-Upon acceptance of the payment schedule by the Engineer, payments for work performed will be made as follows:

(a) The lump sum development cost will be certified for payment.

(b) The Contractor shall demonstrate to the Engineer monthly that the HASP has been kept current and is being implemented and the monthly cost will be certified for payment.

(c) Any month where the HASP is found not to be current or is not being implemented, the monthly payment for the Environmental Health and Safety Item shall be deferred to the next monthly payment estimate. If the HASP is not current or being implemented for more than thirty calendar days, there will be no monthly payment.

(d) Failure of the Contractor to implement the HASP in accordance with this Specification shall result in the withholding of all Contract payments.

Basis of Payment:

This work will be paid for at the Contract lump sum price for "Environmental Health and Safety" which price shall include all materials, tools, equipment and labor incidental to the completion of this item for the duration of the Project to maintain, revise, monitor and implement the HASP. Such costs include providing the services of the HSM and HSO, Contractor employee training, chemical protective clothing (CPC), personal protective equipment (PPE), disposal of PPE and CPC, medical surveillance, decontamination facilities, engineering controls, monitoring and all other HASP protocols and procedures established to protect the Health and Safety for all on-site workers.

Pay Item	Pay Unit
Environmental Health and Safety	L.S.

ITEM #0101117A - CONTROLLED MATERIALS HANDLING

Description:

Work under this Item is intended to provide specific procedural requirements to be followed by the Contractor during the excavation of controlled materials from within any AOEC, as shown on the Project Plans. This supplements Specifications Section 2.02, 2.03, 2.05, and 2.06 and Contract Special Provisions for excavation wherever contaminated materials are encountered. Work under this item shall include transporting and stockpiling materials at the WSA; and covering, securing, and maintaining the stockpiled materials throughout the duration of the Project. All materials, excluding the existing pavement structure (asphalt and subbase), rock, ledge, and concrete excavated within AOECs are to be considered controlled materials. If the vertical limits of the existing subbase cannot be determined visually, subbase will be presumed to extend 12" below the bottom of the existing pavement.

Controlled materials consisting of non-hazardous levels of regulated substances have been documented to exist within the Project. Such contamination is documented in the reports listed in the "Notice to Contractor – Environmental Investigations". Where contaminated soils are excavated, such soil will require special handling, disposal and documentation procedures.

Materials:

The required materials are detailed on the Project Plans. All materials shall conform to the requirements of the Contract.

Plastic Sheet: Polyethylene plastic sheeting for underlayment shall be at least 30 mil thick. Polyethylene plastic sheeting for covering excavated material shall be a thickness of 10 mil. Both shall be at least 10 feet wide.

Sand Bags: Sandbags used to secure polyethylene covers shall be at least 30 pounds.

Sorbent Boom: Shall be 8 inches in diameter and 10 feet long and possess petrophilic and hydrophilic properties. Sorbent booms shall also have devices (i.e. clips, clasps, etc.) for connection to additional lengths of boom.

Construction Methods:

A. General

When controlled materials are encountered during the course of the work, health and safety provisions shall conform to the appropriate sections of the Contract. Provisions may include implementation of engineering controls, air and personal monitoring, the use of chemical protective clothing (CPC), personal protective equipment (PPE), implementation of engineering controls, air and personal monitoring, and decontamination procedures.

Excavated material from the AOECs, if suitable, may be re-used within the AOEC from which it was excavated, in accordance with the following conditions: (1) such soil is deemed to be structurally suitable for use as fill by the Engineer; (2) such soil is not placed below the water table; (3) the CTDEEP groundwater classification of the area where the soil is to be reused as fill does not preclude said reuse; (4) such soil is not placed in an area subject to erosion. Materials removed from any excavation within an AOEC which cannot be immediately re-used within the same AOEC shall be transported directly from their point of origin on the Project to the WSA. The stockpiles of excavated controlled materials shall be maintained as shown on the Project Plans. The Contractor shall plan excavation activities within AOECs in consideration of the capacity of WSA, and the material testing and disposal requirements of the applicable Contract item. **No claims for delay shall be considered based on the Contractor's failure to coordinate excavation activities as specified herein.**

The Engineer will sample the stockpiled controlled materials at a frequency and for the constituents to meet the acceptance criteria of the treatment/recycling/disposal facilities submitted by the Contractor. The Contractor is hereby notified that laboratory turnaround time is expected to be fifteen (15) working days. Turnaround time is the period of time beginning when the Contractor notifies the Engineer which facility it intends to use and that the stockpile is ready for sampling and ending with the Contractor's receipt of the laboratory analytical results. Any change of intended treatment/recycling/disposal facility may prompt the need to resample and will therefore restart the time required for laboratory turnaround. The laboratory will furnish such results to the Engineer. Upon receipt, the Engineer will make available to the Contractor the results of the final waste characterization determinations. **No delay claim will be considered based upon the Contractor's failure to accommodate the laboratory turnaround time as identified above.**

B. Transportation and Stockpiling

In addition to following all pertinent Federal, State and local laws or regulatory agency policies, the Contractor shall adhere to the following precautions during transport of non-hazardous materials:

- Transported controlled materials are to be covered prior to leaving the point of generation and are to remain covered until the arrival at the WSA;

- All vehicles departing the site are properly logged to show the vehicle identification, driver's name, time of departure, destination, and approximate volume and content of materials carried;

- All vehicles shall have secure, watertight containers free of defects for material transportation;

- No material shall leave the site until there is adequate lay down area prepared in the WSA; and,

- Documentation must be maintained indicating that all applicable laws have been satisfied and that the materials have been successfully transported and received at the WSA.

Construction of the WSA shall be completed prior to the initiation of construction activities generating Controlled Materials. Plastic polyethylene sheeting or pavement shall underlay all excavated controlled materials. Measures shall be implemented to divert rainfall away from the WSA.

Placement of sorbent boom along the perimeter of the WSA shall be conducted when soil is saturated with petroleum product.

Excavated materials shall be staged as shown on the Project Plans or as directed by the Engineer.

C. WSA Maintenance

The Contractor shall provide all necessary materials, equipment, tools and labor for anticipated activities within the WSA. Such activities include, but are not limited to, handling and management of stockpiles and drummed CPC/PPE; uncovering and recovering stockpiles; maintenance of WSA; replacement of damaged components (i.e. sand bags, plastic polyethylene sheeting, etc.); and waste inventory record management. The Contractor shall manage all materials in the WSA in such a way as to minimize tracking of potential contaminated materials across the site and off-site, and minimize dust generation.

Each stockpile shall be securely covered when not in active use with a cover of sufficient size to prevent generation of dust and infiltration of precipitation.

The staged stockpiles shall be inspected at least daily by the Contractor to ensure that the cover and containment have not been damaged and that there is no apparent leakage from the pile. If the cover has been damaged, or there is evidence of leakage from the piles, the Contractor shall immediately replace the cover or containment as needed to prevent the release of materials to the environment from the piles.

An inventory of stockpiled materials and drummed CPC/PPE shall be conducted on a daily basis. Inventory records shall indicate the approximate volume of material/drums stockpiled per day;

the approximate volume of material/drums stockpiled to date; material/drums loaded and transported off-site for disposal; any materials loaded and transported for on-site reuse; and identification of stockpiles relative to their points of generation.

Following the removal of all stockpiled controlled materials, residuals shall be removed from surfaces of the WSA as directed by the Engineer. This operation shall be accomplished using dry methods such as shovels, brooms, mechanical sweepers or a combination thereof. Residuals shall be disposed of as Controlled Materials.

D. Dewatering

Dewatering activities shall conform to Items in pertinent articles of the Contract.

E. Decontamination

All equipment shall be provided to the work site free of contamination. The Engineer may prohibit from the site any equipment that in his opinion has not been thoroughly decontaminated prior to arrival. Any decontamination of the Contractor's equipment prior to arrival at the site shall be at the expense of the Contractor. The Contractor is prohibited from decontaminating equipment on the Project that has not been thoroughly decontaminated prior to arrival.

The Contractor shall furnish labor, materials, tools and equipment for decontamination of all equipment and supplies that are used to handle Controlled Materials. Decontamination shall be conducted at an area designated by the Engineer and may be required prior to equipment and supplies leaving the Project, between stages of the work, or between work in different AOEC's.

Dry decontamination procedures are recommended. Residuals from dry decontamination activities shall be collected and managed as Controlled Materials. If dry methods are unsatisfactory as determined by the Engineer, the Contractor shall modify decontamination procedures as required subject to the Engineer's approval.

F. Dust Control

The Contractor shall implement a fugitive dust suppression program in accordance with the Contract to prevent the off-site migration of particulate matter and/or dust resulting from excavation, loading and operations associated with Controlled Materials. It shall be the Contractor's responsibility to supervise fugitive dust control measures and to monitor airborne particulate matter. The Contractor shall:

1. Employ reasonable fugitive dust suppression techniques.
2. Visually observe the amounts of particulate and/or fugitive dust generated during the handling of controlled materials. If the apparent amount of fugitive dust and/or particulate matter is not acceptable to the Engineer, the Engineer may direct the Contractor to implement corrective measures at his discretion, including, but not limited to, the following:

(a) apply water to pavement surfaces
(b) apply water to equipment and excavation faces; and
(c) apply water during excavation, loading and dumping.

G. Permit Compliance

The Contractor shall comply with the terms and conditions of the DEEP "General Permit for Contaminated Soil and/or Sediment Management (Staging and Transfer)", including the General Operating Conditions and the Specific Operating Conditions, except that the Engineer will conduct all soil/sediment characterization and perform all record keeping. In particular, the Contractor shall:

1. Operate, maintain and repair the WSA in conformance with the requirements of the General Permit.
2. Maintain a communications system capable of summoning fire, police, and/or other emergency service personnel.
3. Prevent unauthorized entry onto the stockpiles by the use of fences, gates, or other natural or artificial barriers.
4. Separate incidental excavation waste to the satisfaction of the receiving facility or to an extent that renders the contaminated soil and/or sediment suitable for its intended reuse.
5. Isolate and temporarily store incidental waste in a safe manner prior to off-site transport to a facility lawfully authorized to accept such waste.
6. Not store more that 100 cubic yards of incidental waste at any one time.
7. Sort, separate and isolate all hazardous waste from contaminated soil and/or sediment.
8. Prevent or minimize the transfer or infiltration of contaminants from the stockpiles to the ground as detailed in "B. Transportation and Stockpiling" above.
9. Securely cover each stockpile of soil as detailed in "C. WSA Maintenance" above.
10. Minimize wind erosion and dust transport as detailed in "F. Dust Control" above.
11. Use anti-tracking measures at the WSA to ensure the vehicles do not track soil from the WSA onto a public roadway at any time.
12. Instruct the transporters of contaminated soil and/or sediment of best management practices for the transportation of such soil (properly covered loads, removing loose material from dump body, etc.).
13. Control all traffic related to the operation of the facility in such a way as to mitigate the queuing of vehicles off-site and excessive or unsafe traffic impact in the area where the facility is located.
14. Ensure that except as allowed in section 22a-174-18(b)(3)(C) of the Regulations of Connecticut State Agencies, trucks are not left idling for more than three (3) consecutive minutes.

Method of Measurement:

The work of Controlled Material Handling will be measured for payment by the number of cubic yards of controlled material excavated within the AOECs and taken to the WSA, and stockpiled within the storage bins for sampling by the Engineer. Material kept in proximity to the site of excavation and reused as it is generated will not be measured for payment under this item. This measurement shall be in accordance with and in addition to the quantity measured for payment of the applicable excavation item in Specification Sections 2.02, 2.03, 2.05, 2.06, or the Contract Special Provisions, as applicable. Excess excavations made by the Contractor beyond the payment limits specified in the Contract will not be measured for payment and the Contractor assumes all costs associated with the appropriate handling, management and disposal of this material.

Equipment decontamination, the collection of residuals, and the collection and disposal of liquids generated during equipment decontamination activities will not be measured separately for payment.

Basis of Payment:

This work shall be paid for at the Contract unit price, which shall include all transportation from the excavation site to the final WSA, including any intermediate handling steps; stockpiling controlled materials at the WSA; covering, securing, and maintaining the individual stockpiles within the WSA throughout the duration of the Project; and all tools, equipment, material and labor incidental to this work.

This price shall also include equipment decontamination; the collection of residuals generated during decontamination and placement of such material in the WSA; and the collection and disposal of liquids generated during equipment decontamination activities.

All materials, labor and equipment associated with compliance with the General Permit for Contaminated Soil and/or Sediment Management (Staging and Transfer) will not be measured separately, but will be considered incidental to the item “Controlled Materials Handling”.

Securing, construction and dismantling of the WSA shall be paid for under Item 0101128A. Payment for dust control activities shall be made under the appropriate Contract items.

Pay Item	Pay Unit
Controlled Materials Handling	C.Y.

ITEM #0101128A - SECURING, CONSTRUCTION AND DISMANTLING OF A WASTE STOCKPILE AND TREATMENT AREA

Description:

Work under this Item shall consist of the securing, construction and dismantling of the temporary Waste Stockpile Area at the location designated on the Project Plans and in accordance with the Contract. All controlled materials excavated during construction activities shall be stockpiled in the WSA. The WSA shown on the Plans is to be used exclusively for temporary stockpiling of excavated materials from within Project AOECs and excess material from the LLAOEC for determination of disposal classification.

Materials:

The required materials are detailed on the Project Plans. All materials shall conform to the requirements of the Contract.

Construction blocks shall be solid precast rectangular concrete six feet in length, three in height, and two feet in depth.

Polyethylene plastic sheeting for underlayment shall be a thickness of 30 mil and minimum width of ten (10) feet. Polyethylene sheeting for covering shall be a thickness of 10 mil and minimum width of ten (10) feet.

Sand bags used to secure polyethylene sheeting soil covers shall have a minimum weight of thirty pounds.

Bedding sand shall conform to Section 6.51.02 of the Specifications.

Processed Aggregate Base shall conform to Section 3.04 of the Specifications.

Hay bales shall conform to the requirements of Section 2.18 of the Specifications.

Bituminous Concrete shall conform to Section 4.06 of the Specifications.

Turf Establishment shall conform to Section 9.50 of the Specifications.

Topsoil shall conform to Section M.13.01 of the Specifications.

Roll-off/Storage Containers shall be of watertight, steel-body construction, of the size specified and able to handle the storage and subsequent transportation of material to the disposal facility.

Precast Concrete Barrier Curb shall conform to Section 8.22 of the Specifications.

Construction Methods:

The WSA shall be constructed in accordance with the Contract at the location shown on the Project Plans.

Construction of the WSA shall be completed prior to the initiation of construction activities generating Controlled Materials. The Contractor is responsible for the maintenance and protection of all utilities potentially affected during WSA construction. The Contractor shall locate and mark all existing utilities potentially affected prior to initiating WSA construction.

The proposed location of the WSA shall be cleared of any debris and vegetation as directed by the Engineer. Any objectionable materials, which may result in damage to the polyethylene sheeting underlayment, shall be removed prior to stockpiling excavated controlled materials.

The Contractor shall comply with the terms and conditions of the DEEP "General Permit for Contaminated Soil and/or Sediment Management (Staging and Transfer)", including the General Operating Conditions and the Specific Operating Conditions, except that the Engineer will conduct all soil/sediment characterization and perform all record keeping. In particular, the Contractor shall:

1. Construct and repair the WSA in conformance with the requirements of the General Permit.
2. Prevent unauthorized entry onto the stockpiles by the use of fences, gates, or other natural or artificial barriers.
3. Install anti-tracking measures at the WSA to ensure the vehicles do not track soil from the WSA onto a public roadway at any time.
4. Inspect and cover stockpiled material daily and immediately replace damaged covering as needed.

Following the removal of all stockpiled material, the Contractor shall use dry decontamination procedures for all surfaces of the WSA as directed by the Engineer. Residual materials shall be disposed of as Controlled Materials. If the results from dry methods are unsatisfactory to the Engineer, the Contractor shall modify decontamination procedures as required.

The Contractor shall be responsible for the collection and treatment/recycling/disposal of any liquid wastes that may be generated by its decontamination activities in accordance with applicable regulations.

Upon completion of the Project and following the removal of all residual Controlled Materials, the Contractor shall dismantle the WSA, grade to drain, place topsoil and establish turf to stabilize the area as shown or Directed by the Engineer. During dismantling, the Contractor shall remove all materials such as polyethylene sheeting and sand bags. Materials shall be disposed of by the Contractor as solid waste in accordance with the Contract and all Federal, State and local regulations.

Operation and maintenance of the WSA shall be included under Item 0101117A "Controlled Material Handling".

Method of Measurement:

This work will be measured for payment at the Lump Sum cost for securing, construction, and dismantling of a WSA.

Basis of Payment:

This work will be paid for at the Contract Lump Sum, which shall include all materials, tools, labor, equipment, permits, and work needed to secure, construct, decontaminate and dismantle the WSA, including all clearing, grubbing, grading, clean up, site restoration, including removal of existing fencing, gate, bituminous pavement, etc., turf establishment and seeding.

All materials, labor and equipment associated with compliance with the General Permit for Contaminated Soil and/or Sediment Management (Staging and Transfer) will not be measured separately, but will be considered incidental to the item "Securing, Construction and Dismantling of a Waste Stockpile and Treatment Area".

Pay Item	Pay Unit
Securing, Construction and Dismantling Of a Waste Stockpile and Treatment Area	L.S.

ITEM #0202315A - DISPOSAL OF CONTROLLED MATERIALS

Description:

Work under this item shall consist of the loading, transportation and final off-site disposal/ recycling/treatment of controlled materials (excluding dewatering fluids) that have been generated from various excavations within the AOECs and excess material from the LLAOEC, brought to the WSA and determined to be contaminated with regulated substances at non-hazardous levels. This contamination is documented in the reports listed in the "Notice to Contractor – Environmental Investigations". The controlled materials, after proper characterization by the Engineer, shall be taken from the WSA, loaded, transported to and treated/recycled/disposed of at a permitted treatment/recycle/disposal facility listed herein.

The Contractor must use one or more of the following Department-approved treatment/recycle/disposal facilities for the disposal of non-hazardous materials:

Moretown Landfill 187 Palisades Park Waterbury, VT 05676 802-244-1100 x 226	Northampton Landfill 170 Glendale Road Florence, MA 01062 413-498-0099
ESMI of New York 304 Towpath Road Fort Edward, New York 12828 (800) 511-3764; Peter Hanson	Waste Management of New Hampshire P.O. Box 27065 97 Rochester Neck Road Gonic, NH 03839 (603) 330-2170; Ellen Bellio
Ted Ondrick Company, LLC 58 Industrial Road Chicopee, MA 01020 (413) 592-2566; Alan Desrosiers	ESMI of New Hampshire 67 International Drive Loudon, NH 03307 (603) 783-0228; Stephen Raper
Cranston Sanitary Landfill 1690 Pontiac Avenue Cranston, RI 02920 413-552-3688; Paul Mahoney	South Hadley Landfill, LLC 12 Industrial Drive South Hadley, MA 01075 413-535-3095
Waste Management – Chicopee Sanitary Landfill 161 New Lombard Road Chicopee, MA 01020 413-534-8741	Waste Management – Granby Sanitary Landfill 11 New Ludlow Road Granby, MA 01033 413-467-3200

The Southbridge Recycling and Disposal Park 165 Barefoot Road Southbridge, MA 508-765-9723	Allied Waste Niagra Fall Landfill, LLC 5600 Niagra Falls Blvd. Niagra, NY 14304 716-285-3398; David Hanson
Clean Earth of Philadelphia 3201 S. 61 Street Philadelphia, PA 19153 215-724-5520; Mike Kelly	Clean Earth of Carteret 24 Middlesex Avenue Carteret, NJ 07008 732-541-8909; Cheryl Coffee

Construction Methods:

A. Submittals

The apparent low bidder shall submit in writing, within fourteen days after Bid opening, (1) a letter listing the names of the treatment/recycle/disposal facilities (from the list above) which the bidder, if it is awarded the Contract, will use to receive controlled material from this Project, (2) a copy of the attached "Disposal Facility Material Acceptance Certification" form from each facility, which shall be signed by an authorized representative of each treatment/recycle/disposal facility, and (3) a copy of the facility acceptance criteria and facility sampling frequency requirements from each facility.

Any other Contractor which the Department may subsequently designate as the apparent low bidder shall make the aforementioned submissions within fourteen (14) days from the date on which the Department notifies the Contractor that it has become the apparent low bidder. If, however, the Department deems it is necessary for such a subsequent-designated Contractor to make said submissions within a shorter period of time, the Contractor shall make those submissions within the time designated by the Department.

Failure to comply with all of the above requirements may result in the rejection of the bid.

No facility may be substituted for the one(s) designated in the Contractor′s submittal without the Engineer's prior approval. If the material cannot be accepted by any of the Contractor's designated facilities, the Department will supply the Contractor with the name(s) of other acceptable facilities.

Disposal Facility Materials Acceptance Certification

Project Number _____

Project Location_____

Facility Name_____ Telephone_____

Facility Address_____ Fax_____

_____

_____

The Contractor has supplied the analytical data contained in the report concerning the site investigation performed by the Designer. I have personally reviewed this data and intend to accept the following:

Controlled materials as described in Item # 0202315A Disposal of Controlled Materials for the subject Project at a cost of $_____ per ton for treatment/disposal and an additional $_____ per ton for transportation from the Project to the facility (if applicable).

This intent to accept the material will be subject to and dependent upon the facility's subsequent evaluation of waste characterization determination documentation to be provided to the Contractor by the Engineer.

Authorized Facility
Representative_____/_____
Printed/Typed Name Title

_____/_____
Signature Date

Note: The facility shall attach the acceptance criteria and facility sampling frequency requirements to this document.

DO NOT ALTER FORM IN ANY WAY. FORM MUST BE COMPLETED IN ENTIRETY.

B. Material Disposal

The Engineer will sample materials stored at the WSA at a frequency established by the selected treatment/recycling/disposal facilities. The Contractor shall designate to the Engineer which facility it intends to use prior to samples being taken. The Contractor is hereby notified that laboratory turnaround time is expected to be fifteen (15) working days. Turnaround time is the period of time beginning when the Contractor notifies the Engineer which facility it intends to use and that the bin within the WSA is full and ready for sampling and ending with the Contractor's receipt of the laboratory analytical results. Any change of intended treatment/recycling/disposal facility may prompt the need to resample and will therefore restart the time required for laboratory turnaround. The laboratory will furnish such results to the Engineer. Upon receipt, the Engineer will make available to the Contractor the results of the final waste characterization determinations. **No delay claim will be considered based upon the Contractor′s failure to accommodate the laboratory turnaround time as identified above.**

The Contractor shall obtain and complete all paperwork necessary to arrange for material disposal (such as disposal facility waste profile sheets). It is solely the Contractor's responsibility to co-ordinate the disposal of controlled materials with its selected treatment/recycling/disposal facility(s). Upon receipt of the final approval from the facility, the Contractor shall arrange for the loading, transport and treatment/recycling/disposal of the materials in accordance with all Federal and State regulations. **No claim will be considered based on the failure of the Contractor's selected disposal facility(s) to meet the Contractor's production rate or for the Contractor's failure to select sufficient facilities to meet its production rate.**

All manifests or bills of lading utilized to accompany the transportation of the material shall be prepared by the Contractor and signed by an authorized Department representative, as Generator, for each truck load of material that leaves the site. The Contractor shall forward the appropriate original copies of all manifests or bills of lading to the Engineer the same day the material leaves the Project.

A load-specific certificate of treatment/recycling/disposal, signed by the authorized agent representing the disposal facility, shall be obtained by the Contractor and promptly delivered to the Engineer for each load.

C. Material Transportation

In addition to all pertinent Federal, State and local laws or regulatory agency polices, the Contractor shall adhere to the following precautions during the transport of controlled materials off-site:

· Transported controlled materials are to be covered sufficiently to preclude the loss of

material during transport prior to leaving the site and are to remain covered until the arrival at the selected treatment/recycling/disposal facility.

- All vehicles departing the site are to be properly logged to show the vehicle identification, driver′s name, time of departure, destination, and approximate volume, and contents of materials carried.

- No materials shall leave the site unless a treatment/recycling/disposal facility willing to accept all of the material being transported has agreed to accept the type and quantity of waste.

D. Equipment Decontamination

All equipment shall be provided to the work site free of gross contamination. The Engineer may prohibit from the site any equipment that in his opinion has not been thoroughly decontaminated prior to arrival. Any decontamination of the Contractor's equipment prior to arrival at the site shall be at the expense of the Contractor. The Contractor is prohibited from decontaminating equipment on the Project that has not been thoroughly decontaminated prior to arrival.

The Contractor shall furnish labor, materials, tools and equipment for decontamination of all equipment and supplies that are used to handle Controlled Materials. Decontamination shall be conducted at an area designated by the Engineer and shall be required prior to equipment and supplies leaving the Project, between stages of the work, and between work in different AOEC's.

The Contractor shall use dry decontamination procedures. Residuals from dry decontamination activities shall be collected and managed as Controlled Materials. If the results from dry methods are unsatisfactory to the Engineer, the Contractor shall modify decontamination procedures as required.

The Contractor shall be responsible for the collection and treatment/recycling/disposal of any liquid wastes that may be generated by its decontamination activities in accordance with applicable regulations.

Method of Measurement:

The work of "DISPOSAL OF CONTROLLED MATERIALS" will be measured for payment as the actual net weight in tons of material delivered to the treatment/recycling/disposal facility. Such determinations shall be made by measuring each hauling vehicle on the certified permanent scales at the treatment/recycling/disposal facility. Total weight will be the summation of weight bills issued by the facility specific to this Project. Excess excavations made by the Contractor beyond the payment limits specified in Specification Sections 2.02, 2.03, 2.05, 2.06, or the Contract Special Provisions (as appropriate) will not be measured for payment and the Contractor assumes responsibility for all costs associated with the appropriate handling, management and disposal of this material.

The disposal of excavated materials, originally anticipated to be controlled materials, but determined by characterization sampling not to contain concentrations of regulated chemicals (non-polluted or "clean" materials) will not be measured for payment under this item but will be considered as surplus excavated materials and will be paid in accordance with Article 1.04.05.

Equipment decontamination, the collection of residuals, and the collection and disposal of liquids generated during equipment decontamination activities will not be measured separately for payment.

Basis of Payment:

This work will be paid for at the Contract unit price, which shall include the loading and transportation of controlled materials from the WSA to the treatment/recycling/disposal facility; the fees paid to the facility for treatment/recycling/disposal; the preparation of all related paperwork; and all equipment, materials, tools, and labor incidental to this work. **This unit price will be applicable to all of the listed disposal facilities and will not change for the duration of the Project.**

This price shall also include equipment decontamination; the collection of residuals generated during decontamination and placement of such material in the WSA; and the collection and disposal of liquids generated during equipment decontamination activities.

Pay Item	Pay Unit
Disposal of Controlled Materials	Ton

ITEM #0202318A - MANAGEMENT OF REUSABLE CONTROLLED MATERIAL

Description:

Work under this item shall include all materials, equipment, tools and labor required to load, transport from the WSA, place, and compact reusable controlled materials in fill areas located within the Project limits. "Reusable controlled material" is soil that contains contaminant concentrations above analytical detection limits, but below the applicable regulatory criteria and is reused within the project limits in accordance with the conditions specified.

Construction Methods:

Controlled material stored within the WSA which is determined to be reusable following analytical testing shall be loaded, transported, placed and compacted at fill areas located within the Project limits in accordance with the following conditions: (1) such soil is deemed to be structurally suitable for use as fill by the Engineer; (2) such soil is not placed below the water table; 3) the DEEP groundwater classification of the area where the soil is to be reused as fill does not preclude said reuse; and (4) such soil is not placed in an area subject to erosion.

Method of Measurement:

"Management of Reusable Controlled Material" will be measured for payment by the number of cubic yards of material loaded and transported from the WSA and placed at fill areas located within the Project limits in accordance with the Contract.

Basis of Payment:

"Management of Reusable Controlled Material" will be paid for at the Contract unit price, which shall include all materials, equipment, tools and labor necessary to load and transport reusable controlled materials from the WSA to fill areas located within the Project limits and to place and compact the reusable material. This price shall include any decontamination of soil handling equipment, and the treatment/recycling/disposal of wastes generated in conjunction with such decontamination.

No separate payment will be made for consolidating previously tested individual stockpiles that have been deemed reusable, but shall be considered incidental to the work.

The disposal of any reusable controlled material that fails to meet material testing requirements for the intended use in accordance with the Contract requirements, as well as any excess reusable material, will be paid under Item 0202315A, “Disposal of Controlled Material”.

Pay Item	Pay Unit
Management of Reusable Controlled Materials	C.Y.

ITEM #0406999A - ASPHALT ADJUSTMENT COST

The Asphalt Price is available on the Department of Transportation web site at:

http://www.ct.gov/dot/asphaltadjustment

The asphalt adjustment cost will be based on the variance in price for the performance-graded binder component of hot mix asphalt (HMA), Polymer Modified Asphalt (PMA), and Ultra-Thin Bonded Hot-Mix Asphalt mixtures completed and accepted in the contract.

An asphalt adjustment cost will be applied only if all of the following conditions are met:

I. For HMA and PMA mixtures:

a. The HMA or PMA mixture in which the adjustment is being applied is listed as a contract item with a pay unit of tons or metric tons.

b. The total quantity for all HMA and PMA mixtures in a contract or individual purchase order (Department of Administrative Service contract awards) exceeds 1000 tons or more.

c. The difference between the posted *Asphalt Base Price* and *Asphalt Period Price* varies by more than $5.00.

II. For Ultra-Thin Bonded HMA mixtures:

a. The Ultra-Thin Bonded HMA mixture in which the adjustment is being applied is listed as a contract item.

b. The total quantity for Ultra-Thin Bonded HMA mixture in a contract exceeds:

i. 800 tons (727 metric tons) if Ultra-Thin Bonded HMA is listed as a contract item with a pay unit of tons or metric tons.

ii. 30,000 square yards (25,080 square meters) if Ultra-Thin Bonded HMA is listed as a contract item with a pay unit of square yards or square meters.

Note: The quantity of Ultra-Thin Bonded HMA measured in tons shall be determined from the material documentation requirements set forth in the Ultra-Thin Bonded HMA Special Provision.

c. The difference between the posted *Asphalt Base Price* and *Asphalt Period Price* varies by more than $5.00.

d. No Asphalt Adjustment Cost shall be applied to the liquid emulsion that is specified as part of the Ultra-Thin Bonded HMA mixture system.

III. Regardless of the binder used in all HMA and/or PMA mixtures, the Asphalt Adjustment Cost will be based on PG 64-22.

The Connecticut Department of Transportation (ConnDOT) shall post on its website, the average per ton selling price (asphalt price) of the performance-graded binder. The average is based on the high and low selling price published in the most recent available issue of the **Asphalt Weekly Monitor®** furnished by Poten & Partners, Inc. under the "East Coast Market – New England, New Haven, Connecticut area", F.O.B. manufacturer's terminal.

The selling price furnished from the Asphalt Weekly Monitor ® is based on a standard ton (US$/ST). The metric ton price is determined by applying a factor of 1.1023 (US$/ST x 1.1023 = US$/mton). Example: $150.00/ton x 1.1023 = $165.34/mton

Formula: HMA x $\frac{PG\%}{100}$ x [(*Period Price - Base Price*] = $ ____ , where

- **HMA:**
  1. For HMA, PMA, and Ultra-Thin Bonded HMA mixtures with pay units of mass: The quantity (tons or metric tons) of accepted HMA, PMA, or Ultra-Thin Bonded HMA mixture measured and accepted for payment.
  2. For Ultra-Thin Bonded HMA mixtures with pay units of area: The quantity of Ultra-Thin Bonded HMA mixture delivered, placed, and accepted for payment, calculated in tons or metric tons as documented according to the Material Documentation provision (section E) of the Ultra-Thin Bonded HMA Special Provision.

- ***Asphalt Base Price***: The asphalt price that is posted on the ConnDOT website 28 days before the actual bid opening posted.

- ***Asphalt Period Price***: The asphalt price that is posted on the ConnDOT website for the period in which the HMA, PMA mixture is placed.

- Performance-Graded Binder percentage (**PG%**)

  1. For HMA or PMA mixes:
     PG% = 4.5
     - For Superpave 1.5 inch (37.5mm), Superpave 1.0 inch (25.0mm), PMA S1, HMA S1, and Class 4

       PG % = 5.0
     - For Superpave 0.50 inch (12.5mm), HMA S0.5, PMA S0.5, and Class 1

       PG % = 6.0
     - For Superpave 0.375 inch (9.5mm), HMA S0.375, PMA S0.375, Superpave 0.25 inch (6.25mm), HMA S0.25, PMA S0.25, Superpave #4 (4.75mm) and Class 2

  2. For Ultra-Thin Bonded HMA mixes:

PG% = Design % PGB (Performance Graded Binder) in the approved job mix formula, expressed as a percentage to one decimal point (e.g. 5.1%)

The adjustment shall not be considered as a changed condition in the contract because of this provision and because the Contractors are being notified before submission of bids.

Basis of Payment: The "Asphalt Adjustment Cost" will be calculated using the formula indicated above. A payment will be made for an increase in costs. A deduction from monies due the Contractor will be made for a decrease in costs.

The sum of money shown on the estimate, and in the itemized proposal as "Estimated Cost", for this item will be considered the bid price although payment will be made as described above. The estimated cost figure is not to be altered in any manner by the bidder. If the bidder should alter the amount shown, the altered figure will be disregarded and the original cost figure will be used to determine the amount of the bid for the Contract.

ITEM #0952051A – CONTROL AND REMOVAL OF INVASIVE VEGETATION

Description: This work shall include all materials, labor and equipment necessary for the identification, eradication, removal, and disposal of unwanted vegetation in locations either indicated on the plan sheets or as directed by an Environmental Scientist from the Connecticut Department of Transportation's Office of Environmental Planning (OEP). While any and all invasive species, including those listed on the website for the Connecticut Invasive Plant Working Group's (CIPWG) Invasive Plants Council (http://www.hort.uconn.edu/cipwg/ IPC.html), may be subject to eradication at the direction of the Environmental Scientist, the following species must always be eradicated: tree-of-heaven (*Ailanthus altissima*), Russian and autumn olive (*Elaeagnus angustifolia and E. umbellata*), smooth buckthorn *(Rhamnus cathartica)* and glossy buckthorn (*Frangula alnus*), multiflora rose (*Rosa multiflora*), Japanese barberry (*Berberis thunbergii*), winged euonymus (*Euonymus alata*), shrub honeysuckles (*Lonicera maackii, L. morrowii, L. tartarica,L. X bella, L. xylosteum*), privet (*Ligustrum obtusifolium, L. ovalifolium, L. sinense, L. vulgare*), Oriental bittersweet (*Celastrus orbiculatus*), Japanese knotweed (*Polygonum cuspidatum*), common reed *(Phragmites australis)*, and reed canary grass (*Phalaris arundinacea*). If project-specific invasive species additional to those listed above need to be removed, the Environmental Scientist will give appropriate direction.

All vegetation designated for removal shall be eradicated in its entirety in accordance with the methods submitted by the Contractor and approved by the Environmental Scientist. Some work will be completed within areas where desirable species are present and will remain. The Contractor will be responsible for protection of desirable species that are to remain.

Materials: Mechanical removal shall consist of either manual labor, utilizing a weed wrench or other approved machine, or some other approved method that will enable removal of all root pieces and other parts of the target species while minimizing soil disturbance and avoiding any spread of invasive plant material. Where large infestations of invasive/unwanted vegetation are present and identified on the plans, removal via over-excavation of such vegetation and the underlying soils may be required

All herbicides shall be registered for the species being treated and shall be formulated as applicable for target-species foliar treatment, cut surface, or injection applications. Where work in or immediately adjacent to wetlands is necessary, the product label(s) for any chemical/adjuvant formulation applied must indicate that the formulation is approved for aquatic environments.

Construction Methods: The Contractor shall have sole responsibility for identifying all invasive species present within the invasive removal areas called out in the contract documents prior to the Pre-Construction Meeting. The Contractor shall submit the required invasive removal plan at the Pre-Construction Meeting for the review and approval of the Environmental Scientist. This plan shall include a list of all invasive species present on site, along with a schedule of operations and an outline of construction methodologies for the required control and removal of invasive vegetation specific to each species listed.

While the Environmental Scientist will review the Contractor's delineation and removal plan, the Contractor must be competent to identify invasive vegetation at all times of the year and to prepare a plan for its eradication without assistance.

During the Pre-Construction Meeting, a field review shall be scheduled so that the Contractor and the Environmental Scientist can review the areas of invasive species removal, the specific species required to be removed, and the Contractor's submitted invasive species control plan. At this time, the Environmental Scientist may designate areas for removal that are additional to those shown on the plans. If changes are required to the originally submitted plan, these changes must be submitted to the Environmental Scientist at least 10 days prior to beginning work.

Upon receiving a Notice to Proceed, the Contractor will delineate all areas designated for invasive species removal. The Contractor will be responsible for maintaining this delineation throughout the life of the contract.

The Contractor will not be allowed to begin construction activities in the designated removal areas until all schedules, outlines, and methodologies are approved in writing by the Environmental Scientist. This schedule must take into consideration the time period required between herbicide application and the physical removal of the target species wherever such removal is to occur. No removal work can occur for a minimum of two weeks after herbicide application. In all cases, the submitted schedule shall consider mechanical methods for removal before proposing herbicide application.

The schedule and outline shall include:

1) The type(s) of invasive species identified in the designated area(s);
2) Species specific treatment methods describing a full course of treatment for each species to achieve eradication. These methods must show:
    a. Removal methods planned (e.g. pulling, cutting, spraying, etc);
    b. Types and concentrations of any herbicides to be used, including any adjuvants; and
    c. Schedules showing dates and types of initial, intermediate and final treatments;
3) Any construction activities planned in designated removal area(s) during the eradication period;
4) Disposal methods, including:
    a. Onsite methods and locations; and
    b. Requests for off-site disposal locations;
5) Proof of DEP licensure for herbicide application;
6) A description of safety equipment required; and
7) Procedures for handling chemical spills.

The Contractor shall also:

a. Maintain the labels for herbicides being used in his/her possession;
b. Provide OEP with a 10 day work notice prior to proceeding so that the Environmental Scientist can schedule to be present when appropriate;
c. Conduct all herbicide formulations and applications, including the addition of appropriate surfactants and other adjuvants, in strict conformance with the manufacturer's recommendation and per requirements of regulatory agencies; and
d. Maintain a written record of herbicide application, including the formulation, concentration, area treated, and date for each application, to be provided by the commercial applicator and submitted to the Environmental Scientist following each treatment.

A "treatment period" for each designated area will be derived from the schedule submitted by the Contractor and determined by the following:

1) The first treatment date of the earliest treatable vegetation; and

2) The last treatment date of the latest treatable vegetation

It is anticipated that many species will require more than one season to obtain complete eradication. The treatment period must take into consideration those species that will require follow up treatments and more than one season for complete eradication. Upon completion of the treatment period, the Contractor shall notify the Environmental Scientist in writing of the status of eradication. If the eradication has not been successful, the Contractor shall also submit additional treatment plans. If the Contractor believes that eradication has been achieved, the Contractor shall request a site inspection by the Environmental Scientist for concurrence. If the Environmental Scientist concurs that eradication has been achieved, the area will be subject to a one (1) year warranty starting on the first day following the inspection by the Environmental Scientist. During this period the Contractor will be responsible for any further occurrences of the invasive species inside the delineated area.

The Contractor will be responsible for removal and eradication of all plant material deemed as invasive or unwanted within the delineated area(s) for the duration of the project or until relieved of responsibility of the removal item, and the delineation shall remain in place until this time.

Flush cut brush and trees shall not be more than 2 inches (50mm) above the ground line. Flush cutting shall be performed in a controlled manner that will prevent the spread of parts or seeds of invasive species. Brush hogging or any other clearing method that may promote the spread of invasive plant material is also not permissible.

Broadcast or uncontrolled spray application will not be permitted, and care must be taken to avoid contacting non-target species and/or deterring the recolonization of native species following application.

Remove all twining vines in treetops to the greatest extent possible without damaging the branches of the supporting desired vegetation. Cut and remove vines overtopping tree canopies. Climbing spikes will not be permitted for aerial work.

Prune out any branches on non-treatment plants that are damaged during removal of vegetation. All corrective pruning shall conform to the National Arborists Association Pruning Standards.

The site must be monitored by the Contractor and any new or regrowth treated prior to beginning installation of any landscape plantings.

Processing and disposal of unwanted vegetation shall be done in a controlled manner so as not to spread invasive seed or plant parts within the surrounding areas. All cut invasive vegetation shall be separated from clearing and grubbing operations and all other cleared material. Invasive plant materials may be buried on site within the Department ROW provided that they are under a minimum of 10 feet (3.0 m) of cover on all sides for Japanese knotweed and phragmites and 3 feet (1 m) of cover on all sides for all other species and/or removed from the site and disposed of at the approved location(s) identified in the Contractor's submitted schedule and outline of construction methodologies.

No equipment or vehicles other than that required to complete the work will be permitted in the areas designated for invasive vegetation removal. Any equipment used to process invasive materials, such as chippers and transport vehicles, must be cleaned prior to further use. Processing equipment must also

be cleaned prior to further transport.

Wherever removal operations result in exposed soils, disturbed areas must be vegetatively stabilized with the appropriate seed mix and protected with hay, cellulous fiber mulch, or erosion control matting. The application rate for hay mulch and fiber mulch shall be 3500 lbs per acre (3920 kg/hectare).

Method of Measurement: The control and removal of invasive vegetation will be measured by the number of square yards (square meters) of invasive and unwanted vegetation identified and eradicated as required above, including any required re-treatment of any regrowth or new growth. The area for removal will be delineated prior to treatment and measured for payment. After a review of the delineated areas, the Environmental Scientist may designate additional areas for removal that are not shown on the plans. These additional areas will be delineated, measured for payment, and included as part of the contract work.

Where selective removal is required, the drip line of the invasive vegetation will be measured for payment and shall include larger trees.

Basis of Payment: This work will be paid for at the contract unit price per square yard (square meter) for "Control and Removal of Invasive Vegetation". This payment shall include all labor, materials, tools, and equipment necessary for delineation of the invasive area(s); maintenance of the delineation throughout the project; species identification; and cutting, treating, re-treating, removal, and on or off-site disposal of designated invasive plant material. Off-site disposal of residue shall include the loading, transport, dumping, and fees associated with legal off-site disposal.

- Upon approval of the required schedules, the Contractor will receive a payment equal to 10% of all areas delineated.
- Upon initial treatment as it is described in the schedule of operations, the Contractor will receive a payment equal to 30% of all areas receiving initial treatment.
- Upon successful completion of the treatment period as determined during the site review by the Environmental Scientist, the Contractor will receive a payment equal to 30% of all areas receiving final treatment.
- Upon successful completion of the 1 year warranty period covering all treated areas on the project, the contractor will receive a payment equal to 30% of the areas treated.

Where excavation is required for removal, this work shall be covered under the contract Item “Earth Excavation”. All other vegetation removed shall be included in the Item “Clearing and Grubbing” in accordance with Section 2.01.

Vegetative stabilization of disturbed areas shall be paid for under the respective contract Items: “Turf Establishment”, “Wetland Grass Establishment”, and/or “Conservation Seeding for Slopes”.

Pay Item	**Pay Unit**
Control and Removal of Invasive Vegetation	S.Y. (S.M.)

ITEM #0969000A - PROJECT COORDINATOR

Section 1.05.08 of the Standard Specifications is hereby deleted and replaced with the following:

Description: Under this item the Contractor shall furnish the services of an administrative employee, entitled the Project Coordinator, for this project and to coordinate and expedite all phases of the work required for the project to ensure that the construction schedule is maintained.

The minimum lump sum bid for this item shall be equal to 0.5% of the Contractor's total bid. Failure of the Contractor to bid at least the minimum amount will result in the Department adjusting the Contractor's bid to include the minimum bid amount for this item.

The Project Coordinator shall be submitted for approval by name, in writing, with a resume of his qualifications, within seven (7) calendar days of the award of the Contract, but not later than the Preconstruction Meeting, and shall not be changed without prior written notice to the Department.

This resume must demonstrate the Project Coordinator is experienced and versatile in the preparation, interpretation and modification of the Critical Path Method (CPM) construction schedules. This must include successful completion of at least three (3) construction projects of similar complexity, where he served in a lead scheduling capacity. If the Contractor does not have a person in their company that has these skills, then the Contractor shall engage the services of a Consultant, subject to the approval of the Engineer, for the scheduling work required. If a Consultant is engaged, they shall be present at the first meeting, along with the Project Coordinator, prepared to discuss, in detail, the methods and techniques he proposes to use. Thereafter, the Project Coordinator or the Consultant responsible for updating the CPM Schedule shall attend all meetings between the Contractor, its Subcontractors, and any other meetings, which will affect the CPM schedule. The Contractor shall prepare CPM Schedules utilizing the latest version of Primavera Project Planner software as described more fully hereinafter.

If the Contract includes Article 1.20 the following requirement shall also apply:

The Project Coordinator shall have, in addition to the above noted requirements, a minimum of eight (8) years' experience related to commercial/industrial building construction as a Project Coordinator performing duties similar to those required herein.

The Project Coordinator shall have knowledge of all trades involved in the construction, including civil/site work, environmental work, concrete work, masonry work, steel work, wood work, electrical work, and mechanical work.

Other combinations of experience and education totaling ten (10) years in commercial building construction will be considered subject to the approval of the Engineer.

<u>Computer Software and Printer:</u> The Contractor shall provide the following equipment with all the required maintenance and repairs (to include labor and parts) throughout the Contract life. The Engineer reserves the right to expand or relax the specification to adapt to the software and hardware limitations and availability.

The Contractor shall provide the Engineer with a licensed copy registered in the Department's name of the latest versions of the software listed and maintain customer support services offered by the software producer for the duration of the project. The Contractor shall deliver to the Engineer all supporting documentation for the software and hardware including any instructions or manuals.

A) Software – Minimum Specification:

The Contractor shall provide the Engineer with a licensed copy of the latest version of the Primavera Contractor – Deluxe Version scheduling software, registered in the Department's name, and maintain the Primavera customer support service contract over the duration of the project.

B) HP Officejet Pro K8600 Color Printer – Minimum or equivalent (to be installed as a local printer on a computer provided under the field office specification):

Paper – 11 in x17 in, 8.5 in x 11 in and duplex/double-side print
Resolution – 1200x1200 DPI
Print Drivers – Must support HP PCL6.
RAM – 32 MB RAM
Print speed – 10 ppm – color, 13 ppm - black
Printer cable – 1.8 m (6 ft)

The Contractor is responsible for service and repairs to all computer hardware. All repairs must be performed with-in 24 hours. If the repairs require more than a 24 hours then a replacement must be provided.

Construction Methods: The Project Coordinator shall attend all meetings between the Contractor and the Department, the Contractor and its Subcontractors, and any other meetings that affect the progress of the job. The Project Coordinator shall be knowledgeable of the status of all parts of the work throughout the length of the Contract.

The Contractor shall prepare a CPM Schedule in accordance with the pertinent provisions of "Section 1.03 - Award and Execution of Contract," "Section 1.05 - Control of the Work," and "Section 1.08 - Prosecution of Progress" of the Standard Specifications. The schedule shall incorporate the Sequence of Construction as outlined on the Plans and in the Specifications. All other limiting factors that affect construction shall also be incorporated into the schedule. All milestones or constrained dates within the schedule shall be clearly indicated.

The CPM schedule shall contain a list of activities that represents the major elements of the project. At a minimum, this list should include a breakdown by individual structure or stage, including major components of each. The schedule shall contain sufficient detail to describe the progression of the work in a comprehensive manner. As a guide, 10 to 15 activities should be provided for each $1 million of contract value. The following list of items is provided as an example only and is not meant to be all-inclusive (or all-applicable):

General Items Applicable to all projects
Contractual Constraints

-Environmental permits/application time of year restrictions
-Milestones
-Third Party approvals
-Long lead time items (procurement and fabrication of major elements)
-Adjacent Projects or work by others

Award
Notice to Proceed
Signing (Construction, temporary, permanent by location)
Mobilization
Permits as required
Field Office
Utility Shutdowns
Utility Relocations
Submittals/shop drawings/working drawings/product data
Construction of Waste Stock pile area
Clearing and Grubbing
Earthwork (Borrow, earth excavation, rock excavation, etc.)
Traffic control items (including illumination and signalization)
Pavement markings
Roadway Construction (Breakdown into components)
Drainage (Breakdown into components)
Culverts
Final Plantings (including turf establishment)
Final Cleanup

The following additional guidelines supplement the general guidelines listed above for the specific project types indicated:

A. For buildings and other structures, include major components such as:

Temporary Earth Retention Systems
Cofferdam and Dewatering
Structure Excavation
Piles/test piles
Temporary Structures

Bearing Pads
Structural Steel (Breakdown by fabrication, delivery, installation, painting etc.)

B. Multiple location projects such as traffic signal, incident management, lighting, planting and guiderail projects will be broken down first by location and then by operation. Other major activities of these types of projects should include, but are not limited to:

Installation of anchors
Driving posts
Foundations
Trenching and Backfilling
Installation of Span poles/mast arms
Installation of luminaires
Installation of cameras
Installation of VMS
Hanging heads
Sawcut loops
Energizing equipment

C. Facility Projects shall reflect the same breakdown of the project as the schedule of values:

CSI Division 2 – Existing Conditions
CSI Division 3 – Concrete
CSI Division 4 – Masonry
CSI Division 5 – Metals
CSI Division 6 – Wood, Plastics, and Composites
CSI Division 7 – Thermal and Moisture Protection
CSI Division 8 – Openings
CSI Division 9 – Finishes
CSI Division 10 – Specialties
CSI Division 11 – Equipment
CSI Division 12 – Furnishings
CSI Division 13 – Special ConstructionCSI Division 14 – Conveying Equipment
CSI Division 21 – Fire Suppression
CSI Division 22 – Plumbing
CSI Division 23 – Heating, Ventilating, and Air Conditioning
CSI Division 26 – Electrical
CSI Division 27 – Communications
CSI Division 28 – Electronic Safety and Security
CSI Division 30 – Form 816 Unit Price Site Work
CSI Division 31 – Earthwork
CSI Division 32 – Exterior Improvements
CSI Division 33 – Utilities

Proper relationship between all major activities shall be indicated. Node numbers shall be coded such that the major activities shown on the Critical Path Schedule shall be easily referenced to the Detailed Project Schedule when it is developed. Break down the work covered under each Special Provision, or Division and Section of Article 1.20 of the Standard Specifications, into individual activities required and logically group related activities together within the CPM.

The CPM schedule will be compiled using this list of major activities. It will be the responsibility of the contractor to detail all milestones, environmental permit "window" periods; winter shutdowns etc. and include them on their schedule under the corresponding dates.

If the Engineer determines that additional detail is necessary, the Contractor shall provide it.

All documents, which require approval by the Department, shall be clearly identified within the schedule. The Department and any outside agency shall be allocated a minimum number of calendar days in accordance with Article 1.20-1.05.02. If Article 1.20 does not apply then, the Department shall be allocated a minimum of thirty (30) calendar days (exclusive of weekends and holidays) for review and approval of each submittal. Any submittals requiring approval by an outside Agency (ConnDEEP, Coast Guard, Army Corps of Engineers, etc.) shall be allocated a minimum of sixty (60) calendar days. The Department shall not be held responsible for any delay associated with the approval or rejection of any substitution or other revisions proposed by the Contractor.

The schedule shall indicate the logic of the work for the major elements and components of work under the Contract, such as the planned mobilization of plant and equipment, sequences of operations, procurement of materials and equipment, duration of activities, type of relationship, lag time (if any), and such other information as it is necessary to present a clear statement of the intended activities.

The Contractor is responsible to inform its subcontractor(s) and supplier(s) of the project schedule and any relevant updates.

The schedules shall consist of a network technique of planning, scheduling and control, shall be a clear statement of the logical sequence of work to be done, and shall be prepared in such a manner that the Contractor's work sequence shall be optimized between early start and late start restraints. The Contractor shall use the same criteria in a consistent manner throughout the term of the project. If, at any time, the Contractor alters logic, original durations, and descriptions, adds activities or activity codes or in any way modifies the Baseline Schedule, they must notify the Engineer of the change, in writing, with presentation detailing the reasons for the change. The Engineer reserves the right to approve or reject any such change.

The critical path of the project must be identified on the CPM schedule. The critical path is the longest-duration path through the network. The significance of the critical path is that the activities that lie on it cannot be delayed without delaying the project. Because of its impact on the entire project, critical path analysis is an important aspect of project planning.

The critical path can be identified by determining the following four parameters for each activity:

- ES - earliest start time: the earliest time at which the activity can start given that its precedent activities must be completed first.
- EF - earliest finish time, equal to the earliest start time for the activity plus the time required to complete the activity.
- LF - latest finish time: the latest time at which the activity can be completed without delaying the project.
- LS - latest start time, equal to the latest finish time minus the time required to complete the activity.

The *float time* for an activity is the time between its earliest and latest start time, or between its earliest and latest finish time. Float is the amount of time that an activity can be delayed past its earliest start or earliest finish without delaying the project. Delays to activities on the critical path through the project network in which no float exists, that is, where ES=LS and EF=LF will delay the project.

Float available in the schedule, at any time shall not be considered for the exclusive use of either the State or the Contractor. During the course of contract execution, any float generated due to the efficiencies of either party is not for the sole use of the party generating the float; rather it is a shared commodity to be reasonably used by either party. Project Float will be a resource available to both the State and the Contractor.

Each CPM Schedule submittal shall be in the form of an activity on node diagram (precedence diagramming method) and shall include at a minimum; an Early Start computer sort, a Total Float computer sort, an Activity Number computer sort, a Schedule Diagram in the Time Scaled Logic format and a backup data CD-ROM which includes all Primavera project files. The diagrams shall be on 2' x 3' sheets. Additional, more detailed, diagrams for important aspects or phases of the work will be required on large or complex projects.

Activity I.D. numbers shall be keyed to the item numbers assigned on the detailed estimate sheet. The first three digits (four digits for highway illumination, signing, traffic signals and utility work) of the activity I.D. number shall be identical to the first three digits of the item number in the contract. The remaining digits may be used to provide unique, orderly and sequential I.D. numbers for each activity.

Activity codes shall be added to the schedule dictionary at the direction of the Engineer. At a minimum, activity codes for responsibility (prime, subcontractor by name), location of work (bridge #, span #, sta. #, site, building, type of work, etc.) and stage or phase number should be included.

The Project Coordinator shall be required to prepare and submit the following documents:

1.) Baseline Submittal Requirements: The Contractor shall be guided by the following requirements when submitting the CPM Schedules for review and approval.

a.) Within ten (10) calendar days after award, the Contractor and their scheduler will attend a meeting to discuss the submittal requirements. Within twenty (20) calendar days after contract award, the Contractor shall prepare and submit for review and approval a detailed CPM Schedule for all work. The review and approval process may take up to 21 calendar days and is more fully described in paragraph (b) of this section.

The work shall be broken out into sufficient detail such that no activity has a duration greater than twenty (20) days, unless approved by the Engineer. As a guide, 25 to 35 activities should be provided per $1 million of contract work. The Engineer shall be the sole judge as to whether the schedule is sufficiently detailed.

All work shall be shown in sufficient detail such that the Critical Path may be identified and the schedule shall incorporate all contract milestones. Upon approval, this schedule shall be designated the "Baseline".

Failure to submit and gain approval for the "Baseline" may result in the Contractor being found in violation of Article 1.02.02 of the Standard Specifications. All elapsed contract time prior to the approval of the “Baseline”, will be considered to be accurately represented by the actual as-built schedule of that time period. No claims for delays during that period will be allowed.

The approval of a Baseline Schedule shall in no way waive the requirements of the contract nor shall it excuse the Contractor from any obligations under the contract.

In no instance will the Contractor be permitted to commence work on any significant portion of the work for which a Baseline Schedule has not been approved without prior written approval from the Department.

b.) The Contractor, represented by the Project Coordinator and/or the Consultant, shall participate with the Engineer in the review and evaluation of each schedule submitted. Any and all revisions made necessary as a result of this review shall be made by the Contractor and a revised schedule submitted within ten (10) calendar days. Any further revisions required thereafter shall also be submitted for approval within (10) calendar days.

2.) Monthly Updates: Each month, as of a calendar date mutually acceptable to the Contractor and to the Engineer, the Contractor shall deliver to the Engineer three (3) prints of all required schedule diagrams and tabulations. In addition, the Contractor shall deliver one (1) copy of the project backup data CD-ROM (s), which includes all Primavera project files. The schedule shall be updated to show the work actually accomplished during the preceding months, the actual time

consumed for each activity, and the estimated time remaining for any activity which as been started but not completed.

The monthly update shall also include revisions to the CPM schedule necessitated by revisions to the project, which have been directed by the Engineer (including, but not limited to extra work) during the month preceding the update. Similarly, any changes to the schedule due to Contractor influences shall also be included within the schedule.

Any changes or revisions made to the approved Baseline shall be identified in narrative form in a cover letter accompanying the monthly update. The Engineer reserves the right to approve or reject any such changes. The narrative shall also describe in general terms the progress of the work since the last schedule update and shall identify any items of special interest. If the schedule revisions extend the Contract completion date, due to extra or added work or delays beyond the control of the Contractor, the Contractor must submit a request in writing for an extension of time in accordance with Article 1.08.08. This request should be supported by the schedules submitted previously.

The Contractor shall be responsible to develop mitigation measures for all delays, regardless of responsibility, and to identify all time and cost impacts to the work associated with those mitigation measures.

Except as otherwise authorized by the Engineer, monthly submissions received after the due date are considered late.

The reports required for each monthly update shall include all reports generated for approval of the CPM Schedule for that particular portion of the work. On larger or complex projects, the Engineer may require the schedule data sorted by an activity code to better reflect the progression of the work. Summary barcharts may also be required.

3.) Biweekly Schedules: Each week, the Contractor shall be required to produce and submit to the Engineer a biweekly schedule showing all activities planned for the following two week period. This short term schedule may be handwritten; however a two week “look ahead” filter from the CPM Schedule is preferred. The biweekly schedule shall clearly indicate all work planned on a crew basis for the two week period.

4.) Recovery Schedules: If, in the opinion of the Engineer, the updated schedule indicates that the Project has fallen behind schedule, or that a revision in sequence of operations may be necessary for any other reason, absent a justifiable time extension, the Contractor shall immediately institute all necessary steps to improve it’s progress and shall submit such revised network diagrams, tabulations and operational plans, as may be deemed necessary by the Engineer, to demonstrate the manner in which an acceptable rate of progress will be regained.

Should the Contractor not demonstrate an ability to regain an acceptable rate of progress, the Engineer shall require the schedule to be resource loaded with the next monthly update. No additional compensation will be allowed for resource loading the schedule.

5.) As-Built Schedules: Within thirty (30) days of completion of the project, including all corrective work, the Contractor shall submit an "As-Built Schedule" showing the actual progress of work. The Contractor shall submit three prints of this final CPM Schedule and one project backup data CD-ROM which include all Primavera project files for the Engineer's exclusive use.

If the contract includes Article 1.20 the following shall also apply:

6.) Daily Construction Reports: The Project Coordinator shall assist the Engineer in the preparation of a daily construction report by ensuring that each of the Contractor's employees and subcontractors working on the Project Site on a given day signs the Engineer's sign-in sheet for that day; and by keeping and providing to the Engineer its own daily list of employees and subcontractors who worked on the Project Site on that day.

Method of Measurement: Within ten (10) calendar days of the award of the Contract, the Contractor shall submit to the Engineer for approval a breakdown of its lump sum bid price for this item detailing:

1.) The development cost to prepare the Baseline Schedule in accordance with these specifications. Development costs shall not exceed 25% of the total cost of the item and shall include costs to furnish and install all specified hardware.

2.) The cost to provide the services of the Project Coordinator, including costs to prepare and submit the Monthly Updates; furnish and submit any Recovery Schedules; furnish and submit Two Week Look Ahead Schedules and maintenance of and supplies for the specified hardware noted above. A per month cost will be derived by taking this cost divided by the number of Contract months remaining from the date of acceptance of the Baseline Schedule.

3.) The cost of submission and certification of the As-Built Schedule in accordance with these specifications. The submission and certification costs shall be no less than 2% of the total cost of the item.

4.) Substantiation showing that the costs submitted are reasonable based on the Contractor's lump sum bid.

Upon approval of the payment schedule by the Engineer, payments for work performed will be made as follows:

1.) Upon approval of the "Baseline" Schedule by the Engineer, the lump sum development cost will be certified for payment.

2.) Upon receipt of each monthly update of the "Baseline" Schedule, the per month cost for the services of the Project Coordinator will be certified for payment.

3.) Upon approval of the As-Built Schedule by the Engineer, the lump sum submission and certification cost will be certified for payment.

Basis of Payment: This service will be paid for at the contract lump sum price for "Project Coordinator" complete, which price shall include the preparation and submission of all schedules, updates, reports and submittals. The lump sum price shall also include the cost of providing a complete, licensed copy of the Primavera software which will remain the property of the Engineer, and all materials, equipment, labor and work incidental of this service.

The lump sum price will be certified for payment as described in "Method of Measurement" subject to the following conditions:

1) Any month where the monthly update of the "Baseline" CPM schedule is submitted late, without authorization from the Engineer, will result in the following actions:

a.) The monthly payment for the Project Coordinator item shall be deferred to the next monthly payment estimate. If any monthly submittal is more than thirty (30) calendar days late, there will be no monthly payment for the services of the Project Coordinator.

b) The greater of 5% of the monthly payment estimate or $25,000 shall be retained from the monthly payment estimate until such time as the Contractor submits all required reports.

c.) If in the opinion of the Engineer, the contractor is not in compliance with this specification, the Engineer may withhold all project payments.

2) In the event the project extends beyond the original completion date by more than thirty (30) calendar days, and a time extension is granted to the Contractor, the Department may require additional CPM updates which will be paid at the per month cost for the services of the Project Coordinator.

3) If in the opinion of the Engineer, the contractor is not in compliance with this specification or has failed to submit a "Baseline", monthly update or Recovery Schedule for any portion of the work in accordance with this specification shall result in the withholding of all contract payments until the schedule is submitted to, and approved by, the Engineer.

Pay Item	Pay Unit
Project Coordinator	L.S.

ITEM #0969050A – DOCUMENT CONTROL SPECIALIST

Description: Under this item the Contractor shall furnish the services of an administrative employees, entitled Document Control Specialist who will ensure that the Contractor and all other parties as designated by the Engineer will prepare, status, electronically file and send all project correspondence and drawings utilizing a document control system as established and maintained by the Department. The primary function of the document control system is to ensure timely processing of all contract documentation in coordination with the project schedule. This document control system will also provide uniform project information and reporting. The Document Control Specialist shall be designated by name, in writing with a resume of their qualifications, within five (5) calendar days of the award of the Contract and shall not be changed without prior written notice to the Department.

The Document Control Specialist shall be knowledgeable of the status of all contract documentation aspects of the work throughout the length of the Contract. The Contractor shall prepare and maintain the contract documentation utilizing the SharePoint document control system. The document control system will be physically located in a secure location designated by the Department. The Contractor will directly access the document control system via the internet. The Department will provide the Contractor access to the SharePoint Document Control System. All references to the use of SharePoint shall refer to the Engineer's shared document control system as described above. All information that resides on the shared document control system shall become the sole property of the Engineer.

The minimum lump sum bid for this item shall be equal to 0.25% of the Contractor's total bid. Failure of the Contractor to bid at least the minimum amount will result in the Department adjusting the Contractor's bid to include the minimum bid amount for this item.

Documentation Requirements: All correspondence for the project shall be produced and controlled using SHAREPOINT, including, but not limited to: transmittals, meeting minutes, requests for information (RFI's), requests for change (RFC's), submittals, field memos, notices, letters, and punch lists. All common correspondence files (submittals, requests, answers, changes, reports, minutes, agendas, letters, etc) shall be generated from, and stored within the common file server, including any and all file attachments. Submittals, including shop drawings, working drawings, catalog cuts, material certifications, and all documentation required by contract, shall be submitted electronically via SHAREPOINT. Original hardcopy documents may still be required as determined by the Engineer. The Contractor is responsible to coordinate the overall creation and submission of all project documentation to meet the requirements of the project schedule and Technical Specifications. The Contractor is encouraged to supply the Engineer with corporate logos and letter templates to facilitate the creation and utilization of custom forms and reports.

The named Document Control Specialist shall be designated as the Submittal Coordinator and will be responsible for maintaining information related to the responsibility, status, elapsed time since submission, held time, start/finish times, and a history of all submittal revisions. A submittal log must be maintained to indicate the latest construction submittals sent and received and the distribution of these drawings to the Department. Each submittal (shop drawing, working drawing, product data, samples, etc) must be individually entered, tracked, and the status maintained, including all revisions. The Contractor is responsible to utilize the latest drawings marked "Conforms" or "Conforms as Noted" as identified in the control system. All revisions are to be logged into the control system, describing each change.

All meeting minutes shall be logged into the control system. The Contractor is responsible to utilize meeting minutes and respond (electronically) to meeting minute items assigned to the Contractor.

Documents (letters, logs, shop or working drawings, sketches, payrolls, etc) to be transmitted to the Department by the Contractor, for which the Contractor does not have an electronic version, shall be scanned, converted into an Adobe Acrobat PDF format, and attached accordingly in SharePoint.

The document control system shall be available for Contractor use at all times unless system maintenance (i.e. backups, upgrades, etc) is being performed. System maintenance will generally be limited to 10 PM – 6AM, Monday - Friday and at various times on weekends. In the event a Contractor's authorized user cannot access the control system, the Contractor shall notify the Department's control system representative. In the event the control system becomes unavailable during normal business hours for an extended period of time, the Contractor may issue correspondence requiring immediate attention by the Department in hard copy format. The hard copy correspondence must be entered into the control system immediately upon becoming available again. Inability by the Contractor to gain access to the document control system for any reason shall not be grounds for claim. The use of the database is not required for proprietary cost and contract information.

The Department shall be allocated a minimum of ten (10) calendar days (using a 7-day calendar, exclusive of holidays) for review and response to each RFI submitted. RFI's requiring information from outside agencies shall be allocated twenty-one (21) days (using a 7-day calendar, exclusive of holidays).

The Department shall be allocated a minimum of thirty (30) calendar days (using a 7-day calendar, exclusive of holidays) for review and response to each RFC submitted. RFC's requiring information from outside agencies shall be allocated sixty (60) days (using a 7-day calendar, exclusive of holidays).

The Department reserves the right to reject any RFC submitted in the form of an RFI for the purpose of reducing the Department's review and response time. Such documents will not be considered for review by the Department and will be returned to the Contractor for resubmission.

Review and response time for such document will commence upon resubmission in the correct format.

The Department shall be allocated a minimum of twenty-one (21) calendar days (using a 7-day calendar, exclusive of holidays) for review and approval of each submittal, unless specified otherwise within the contract documents. Any submittals requiring approval by an outside Agency shall be allocated a minimum of sixty (60) calendar days (using a 7-day calendar, exclusive of holidays). A schedule of submittals shall be submitted to The Department for review prior to the start of construction. These durations are a MINIMUM, and will likely increase with the number of outstanding submittals in The Department's possession. Therefore, whenever multiple Contractor submittals are under review by the Department, the Contractor shall prioritize the submittals and notify the Department thereof. The submittal schedule must be submitted early for review as a subset of the baseline schedule. The Department shall not be held responsible for any delay associated with the approval or rejection of any substitution or other revisions proposed by the Contractor.

Submittal and review activities are required in the Project Schedule per Item No. 0969000A, Project Coordinator. Submittal activities must be coordinated between the Project Coordinator and Document Control Specialist such that submittal information common to both the project schedule and the document control system (required and actual dates, sequence of submission, resubmissions if required) correspond with one another. All resubmissions shall be numbered with the original submittal number but designated a new revision number. All resubmissions shall be logged into the control system to properly calculate the entire duration required for the submittal process from the original submission date to final approval to indicate total days to process the submittal through all review cycles. Coordination of submittals is required for same work and interfacing work so that one submittal will not delay another.

Refer to the following Notices to Contractor for additional submittal requirements:

- Submittals
- Early Submittals
- FM Global Submittals
- Closeout Documents
- Potential for Asbestos Containing Materials

The submittal log will be developed according to the following format:

<u>Submittal Package</u>
The Package name shall be the seven digit Item Number. The Package Title shall be the corresponding Item Name. Instances where contract items require an extensive number of submittals (i.e. rebar, structural steel, etc), packages shall be further separated by structure components or location. For example:

Package	Title
0602006-01	Deformed Steel Bars – Epoxy Coated / Abutment 2
0602006-02	Deformed Steel Bars – Epoxy Coated / PN-13
0602006-03	Deformed Steel Bars – Epoxy Coated / PN-14

Instances where a submittal requires review by more then one department or agency, the multiple reviewers option must be checked so that the individual reviewers can be designated, with each receiving a copy of the submittal for review.

The Package status shall initially be "Unsubmitted". Upon submission of any submittal within the package, the status should be changed to "Open". Upon receipt of all final review comments for all package submittals, the status should be changed to "Closed". Submittals that do not require review and approval (i.e. certified payrolls, backup information, etc) shall have a status of "SAC" (submitted and closed).

Submittal Item

All submittal items, as required by contract, must be individually entered, including shop & working drawings, product data, samples, etc. All submittals shall be associated with and generated within a specific package. The submittal number shall be the package name followed by a three digit incremental number (i.e. 1205201-01-001, 0602006-03-001). The Title shall be a clear description of the submittal item. In the case of a drawing submittal, the title shall be the exact name of the drawing and the drawing number shall be entered in the Details section. The appropriate Category and Type shall then be selected.

The Contractor shall examine and check each submittal for accuracy, completeness, coordination with related submittals and compliance with the Contract before it is transmitted to the Designer for review. The Contractor shall sign and submit the Submittal Register Form (sample attached to this section) with each submittal which includes the following statement: "Having reviewed this submittal, I certify that it is complete, accurate, coordinated in all aspects of the item being submitted and conforms to the requirements of the Contract in all respects, including all Federal requirements such as "Buy America", except as otherwise noted." By reviewing and certifying each submittal, the Contractor represents that he has determined and verified materials, field measurements and field construction criteria related thereto, and has checked and coordinated information contained within such submittals with requirements of the Work and the Contract. Shop drawings submitted without this signed statement will be rejected immediately and returned to the Contractor.

Shop drawings shall be submitted in Adobe Acrobat PDF Package format. Each drawing will be included as a separate file within the package and named in kind with the drawing number. The PDF package shall be listed and attached in SHAREPOINT to the first submittal. The drawings shall be listed individually thereafter.

Working drawings shall be submitted in Adobe Acrobat PDF format. The PDF package shall be listed and attached in SharePoint to a single submittal. The drawings shall be listed individually thereafter.

Electronic submittal attachments shall be named in kind with the submittal to which they are attached and include the revision number (ie. Submittal 0602006-03-001 would have a PDF attachment named 0602006-03-001-1.pdf).

Submittal of samples for review and approval by the Designer shall be submitted using a SharePoint-generated transmittal. The Contractor shall ship the quantity of physical samples required by the contract to the Designer with the hard copy of the transmittal. The Designer shall generate the return transmittal in SharePoint (indicating the sample's review status as to Conforms, Conforms as Noted, Revise and Resubmit, Rejected, or No Action Required) and transmit it to the Contractor. The Designer shall retain one set of samples marked "Conforms" or "Conforms as Noted", transmit one set of same to the Engineer, and transmit the remaining sets of same to the Contractor.

Submittals requiring a signature by a licensed engineer or other party shall be digitally signed utilizing a digital ID obtained from an Adobe partner Certified Document Service (CDS) provider (see adobe.com for the list of CDS providers).

Required Start & Expected Finish shall represent the date range for the review process. Required Start shall be the date the submittal is issued by the Contractor for review. Expected Finish shall be the completion date for the review cycle (either 21 or 60 days later, as appropriate).

Workflow must be completed for each submittal. Received From shall be the party from which the submittal originated (prime contractor, subcontractor, fabricator, vendor, etc). Sent To and Returned By shall be the primary reviewer as designated by the contract documents. Forwarded To shall be the Contractor's designated submittal coordinator.

Review cycles will be numbered 001, 002, 003, etc. according to the number of resubmissions. Distributions (submittal recipients) must be listed on the transmittal.

Hard copies of all submittals marked "Conforms" or "Conforms as Noted" shall be transmitted within 5 working days. The Contractor shall submit hard copies of all letters signed in ink with any attachments to the addressee (original) and the ConnDOT District Office (copies) for their records. Scans of signed letters and their attachments shall be stored in SharePoint by the Contractor. The Contractor shall submit wet stamped hard copies of all conformed shop drawings requiring the signature of a professional engineer (eg, steel bar joists, etc.) to the Department for their records. Scanned copies of these conformed shop submittals or other electronic copies will be stored by the Contractor in SharePoint. The Contractor shall submit hard copies and electronic copies of Maintenance Manuals and Warranties.

Submittal Forecast

In order to facilitate the Department's review of the large number of submittals anticipated for this project, the Contractor is to provide a submittal schedule in accordance with the Standard Specifications (Form 816) Section 1.20-1.05.02 Subsection 3, and as described herein. The submittal schedule will be created and maintained in SharePoint as follows:

A submittal package must be created for each contract item requiring a submittal (note that large submittal items must be broken out as prescribed above). Within each package, a single submittal, numbered 001, will be generated from the submittal package which will be utilized to approximate when submittals for that package will be submitted for review. At a minimum, the submittal Number, Title, Status, Required Start, and Required Finish must be entered, where the Status is "Unsubmitted" and the Required Start and Required Finish represents the review period for all submittals within this package. The Required Start and Required Finish dates must be coordinated with the project CPM schedule.

Additionally, the Contractor shall prepare and distribute a 60 day "Look Ahead Submittal Schedule", to be updated weekly and presented and discussed at the project coordination meeting as part of the standing meeting agenda. The Look Ahead Submittal Schedule will be based on the CPM schedule (without limitation on early submittals), and will provide the following in matrix/spreadsheet format:

- Contract Item No. (Note - for the MLSI, provide CSI Division No. & Specification Section No.)
- Contractor's best estimate to identify the actual submittals to be made for those Contract Items or specification sections with multiple submittals
- Contractor's best estimate of a target date the identified submittals will be made
- Identification of planned "Hot Submittals" needed to support near-term construction activities
- Identification of planned "Major Submittals" which are anticipated to require significant review effort (e.g., coordination drawings)

Documentation Control System Access Requirements: Within five (5) days of Contract Award, the Contractor shall designate, in writing, up to five (5) named Contractor personnel, to be approved and authorized by the Engineer to access the document control system. The Contractor shall designate one of the ten authorized personnel to be the Document Control Specialist and act as the document control system contact person for the Contractor. That person shall be experienced and trained in the use of SHAREPOINT. All Contractor personnel requesting access authorization must complete the minimum training requirements described below and submit a certificate of completion to the Department. Upon receipt of the request (with training certificate(s)) and approval thereof, the Department will issue a username and password to each of the authorized Contractor personnel. The Contractor will ensure that only authorized Contractor personnel access and utilize the control system in a responsible, non-destructive manner. The Contractor shall make every reasonable effort to prevent the disclosure of access information for unauthorized use of the control system. The Department, at its

discretion, may revoke access authorization from any user if it is determined that the user: a) has used the control system for any other reason then is intended by this specification; b) is no longer in the Contractor's employ or associated with the project or c) has disclosed their access authorization for use by another person or party for any reason. The Contractor is responsible to ensure their authorized users have access to the public internet from a computer system running any currently supported Microsoft Windows Operating System and Microsoft Internet Explorer Web Browser with a minimum Cipher Strength of 128 bit, version 8.0. Minimum modem speed shall be 768K (business DSL). The Contractor is responsible to ensure that anti-virus software is installed and maintained on any computer accessing the Department's document control system. Additionally, it is the Contractor's sole responsibility to maintain a compatible software system. Compatibility is defined as the ability to send and receive documents in a format viewable by the Department. The Contractor must provide valid individual email addresses for each authorized user to the Department based upon a MAPI compliant email system, such as Microsoft Outlook or Exchange.

Training Requirements: Contractor personnel accessing the document control system must fulfill minimum training requirements as follows: Personnel must attend a two (2) day project specific SharePoint training class provided by Michael Baker Engineering, Inc. Training requests are to be made through the Engineer. The Contractor must supply an acceptable training facility within 15 miles of the project site. The costs of all Contractor personnel training and the training facility are the responsibility of the Contractor. Training facility shall have a computer workstation for each student in addition to a computer for the instructor. The instructor computer must be able to project to a screen/wall for classroom illustrations via a digital projector or large screen monitor (Minimum 40"). The computer workstations must be a minimum Pentium 2 GHz with 2GB of RAM, 200MB free disk space, running Windows 7. Additional workstation requirements include Microsoft TCP/IP networking protocol and a valid IP address, Microsoft Internet Explorer 8.0, 24-bit or higher color video, and 1028x764 video resolution minimum.

Any additional training required as a result of adding additional or replacing existing Contractor staff, including additional costs associated with meeting hardware requirements to run the latest version of the software at that time, shall be included in the total cost of this item.

Submittals: Within thirty (30) calendar days after award, the Submittal Coordinator shall prepare, in accordance with all requirements of this specification, and submit for review and acceptance, a Submittal Forecast and shall have the following requirements attached:

- Submittal Packages Summary Report
- Submittal Bar Chart Report

Method of Measurement: Within ten (10) calendar days of the award of the Contract, the Contractor shall submit to the Engineer for approval a cost breakdown of his lump sum bid price. The submission must include substantiation showing that the costs breakdown submitted are reasonable based on the Contractor's lump sum bid. The cost breakdown shall be in accordance with the following payment schedule:

1) The cost to successfully complete all preparation and training to utilize the document control system in accordance with these specifications. The preparation and training costs shall not exceed 5% of the total cost of the item and shall include costs to establish customized forms or reports, back enter and scan all contract documentation prior to the access authorization, and to furnish and install all specified hardware.

2) The development cost to prepare the Submittal Forecast in accordance with these specifications shall not exceed 5% of the total cost of the item. Payment for this work will be made upon acceptance of the Submittal Forecast by the Engineer.

   The cost to provide services of the Document Control Specialist, including costs to maintain the Submittal Forecast; Coordinating the Document Control System submittal information with the CPM Schedule submissions; preparing, submitting, utilizing, maintaining, coordinating and updating document control system items as required by all Contractor personnel with access rights to the system Shall be paid as a per month cost and shall be derived by taking this cost divided by the number of contract months.

Basis of Payment: This service shall be paid for at the contract lump sum price for "Document Control Specialist" complete, which price shall include the training, preparation, statusing, electronically scanning, filing, and sending all project correspondence, and the furnishing, maintenance, and supply costs for all required hardware, software, and services as noted above in the utilization of the document control system as established and maintained by the Department. The lump sum price will be certified for payment as described in "Method of Measurement" subject to the following conditions:

1) Failure by the Contractor to utilize and regularly update the specified SHAREPOINT database in a manner acceptable to the Department or failure to utilize the common file server for the storage of all project related files may result in the withholding of all contract payments until such time as all specification requirements have been satisfied. Failure by the designated Document Control Specialist to update submittal statuses on a regular basis shall result in the replacement of the Document Control Special at the Engineer's request. Additionally, the Contractor may be found in violation of Article 1.02.02 of the Standard Specifications "for having failed to prosecute work continuously, diligently and cooperatively in an orderly sequence".

2) In the event the project extends beyond the original completion date by more than thirty (30) calendar days, and a time extension is granted to the Contractor, the Department may require the continued utilization of the Document Control System which shall be paid at the per month cost for the services of the Document Control Specialist.

Pay Item	Pay Unit
Document Control Specialist	L.S.

SUBMITTAL REGISTER FORM

The use of this Submittal Register Form is required for all submittals

Project Name: WATERBURY BUS MAINTENANCE FACILITY REPLACEMENT
Watertown, CT
State Project No. 0431-0006
Connecticut Department of Transportation

Design Engineer: Wendel

Contractor: _____

Address: _____

Telephone No.: _____

Subcontractor: _____

Address: _____

Telephone No.: _____

Submittal Number: _____

Submittal Title: _____

Specification Section and Paragraph Number: _____

Contract Drawing and Detail Reference: _____

Date of Initial Submittal: _____

Date of this Submittal: _____

CPM Activity Number: _____

This Submittal Prepared By: _____

Having reviewed this submittal, I certify that it is complete, accurate, coordinated in all aspects of the item being submitted and conforms to the requirements of the Contract in all respects, including all Federal requirements such as "Buy America" except as otherwise noted.

By: _____
Signature

_____
Printed or Typed Name

_____
Title

_____
Date

ITEM #0969062A - CONSTRUCTION FIELD OFFICE, MEDIUM

Description: Under the item included in the bid document, adequate weatherproof office quarters will be provided by the Contractor for the duration of the work, and if required, for a maximum of ninety days thereafter for the exclusive use of ConnDOT forces and others who may be engaged to augment ConnDOT forces with relation to the contract. The office quarters shall be located convenient to the work site and installed in accordance with Article 1.08.02, this office shall be separated from any office occupied by the Contractor. Ownership and liability of the office quarters shall remain with the Contractor.

Materials: Materials shall be in like new condition for the purpose intended and shall be approved by the Engineer.

Office Requirements: The Contractor shall furnish the office quarters and equipment as described below.

	Description:
400 SF	Sq. Ft. of floor space with a minimum ceiling height of 7 ft. and shall be partitioned as shown on building floor plan as provided by the Engineer.
2 EA	Minimum number of exterior entrances.
7 EA	Minimum number of parking spaces.

Office layout: The office shall have a minimum square footage as indicated in the table above, and shall be partitioned as shown on building floor plan as provided by the Engineer. The underside of the office shall be fully skirted to the ground.

Lavatory Facilities: The Contractor shall furnish lavatory and toilet facilities at a location convenient to the office quarters for the use of Department personnel and such assistants as they may engage. He shall also supply lavatory and sanitary supplies as required.

Windows and Entrances: The windows shall be of a type that will open and close conveniently, shall be sufficient in number and size to provide adequate light and ventilation, and shall be fitted with locking devices, blinds and screens. The entrances shall be secure, screened, and fitted with a lock for which four keys shall be furnished. All keys to the construction field office shall be furnished to the Department and will be kept in their possession while State personnel are using the office. Any access to the entrance ways shall meet applicable building codes and be slip resistant, with appropriate handrails.

Lighting: The Contractor shall equip the office interior with electric lighting that provides a minimum illumination level of 100 foot-candles at desk level height, and electric outlets for each desk and drafting table. The Contractor shall also provide exterior lighting that provides a minimum illumination level of 2 foot-candles throughout the parking area and for a minimum distance of 10 ft. on each side of the field office.

The Contractor shall provide the following additional equipment, facilities, and/or services at the Field Office on this project to include at least the following to the satisfaction of the Engineer:

Parking Facility: Adequate parking spaces with adequate illumination on a paved surface, with surface drainage if needed. If paved parking does not exist adjacent to the field office, the Contractor shall provide a parking area of sufficient size to accommodate the number of vehicles indicated in the table above. Construction of the parking area and driveway, if necessary, will consist of a minimum of 6 inches of processed aggregate base graded to drain. The base material will be extended to the office entrance.

Field Office Security: Physical Barrier Devices - This shall consist of physical means to prevent entry, such as: 1) All windows shall be barred or security screens installed; 2) All field office doors shall be equipped with dead bolt locks and regular day operated door locks; and 3) Other devices as directed by the Engineer to suit existing conditions.

Electric Service: The field office shall be equipped with an electric service panel to serve the electrical requirements of the field office, including: lighting, general outlets, computer outlets, calculators etc., and meet the following minimum specifications:

A. 120/240 volt, 1 phase, 3 wire.
B. Ampacity necessary to serve all equipment. Service shall be a minimum 100 amp dedicated to the construction field office.
C. The electrical panel shall include a main circuit breaker and branch circuit breakers of the size and quantity required.
D. Additional 120 volt, single phase, 20 amp, isolated ground dedicated power circuit with dual NEMA 5-20 receptacles will be installed at each computer workstation location.
E. Additional 120 volt, single phase, 20 amp, isolated ground dedicated power circuit with dual NEMA 5-20 receptacles will be installed, for use by the Telephone Company.
F. Additional 120-volt circuits and duplex outlets as required meeting National Electric Code requirements.
G. One exterior (outside) wall mounted GFI receptacle, duplex, isolated ground, 120 volt, straight blade.
H. After work is complete and prior to energizing, the State's ConnDOT electrical inspector, must be contacted at 860-594-2240. (Do Not Call Local Town Officials)
I. Prior to field office removal the ConnDOT Data Communications office must be notified to deactivate the communications equipment.

Heating, Ventilation and Air Conditioning (HVAC): The field office shall be equipped with sufficient heating, air conditioning and ventilation equipment to maintain a temperature range of 68°-80° Fahrenheit within the field office.

The Following Furnishings and Equipment Shall Be Provided In The Applicable Field Office Type:

Qty	Description:
3 EA	Office desks (2.5 ft x 5 ft) with drawers, locks, and matching desk chairs that have

Qty	Description:
	pneumatic seat height adjustment and dual wheel casters on the base.
2 EA	Office Chairs.
1 EA	Fire resistant cabinets (legal size/4 drawer), locking.
1 EA	Drafting type tables (3 ft x 6 ft) and supported by wall brackets and legs; and matching drafters stool that have pneumatic seat height adjustment, seat back and dual wheel casters on the base.
2 EA	Personal computer tables (4 ft x 2.5 ft).
1 EA	Hot and cold water dispensing unit and supply of cups and bottled water shall be supplied by the Contractor for the duration of the project.
2 EA	Electronic office type printing calculators capable of addition, subtraction, multiplication and division with memory and a supply of printing paper.
2 EA	Telephone.
1 EA	Telephone answering machine.
1 EA	Plain paper facsimile (FAX) machine capable of transmitting via telephone credit card. All supplies, paper and maintenance shall be provided by the Contractor.
1 EA	Copier/Scanner - dry, plain paper with automatic feeder and reducing capability. All supplies, paper and maintenance shall be provided by the Contractor.
2 EA	Computer systems as specified below under Computer Hardware and Software. All supplies and maintenance shall be provided by the Contractor.
1 EA	Laser printer as specified below under Computer Hardware and Software. All supplies, paper and maintenance shall be provided by the Contractor.
2 EA	Digital Camera as specified below under Computer Hardware and Software. All supplies and maintenance shall be provided by the Contractor.
1 EA	Wastebaskets - 30 gal., including plastic waste bags.
3 EA	Wastebaskets - 5 gal., including plastic waste bags.
2 EA	Electric pencil sharpeners.
* EA	Fire extinguishers - provide and install type and number to meet applicable State and local codes for size of office indicated, including a fire extinguisher suitable for use on a computer terminal fire.
1 EA	Vertical plan racks for 2 sets of 2 ft x 3 ft plans for each rack.
1 EA	Infrared Thermometer, including certified calibration, case, cleaning wipes.
1 EA	Concrete Curing Box as specified below under Concrete Testing Equipment.
1 EA	Concrete Air Meter as specified below under Concrete Testing Equipment.
1 EA	Concrete Slump Cone as specified below under Concrete Testing Equipment.

The furnishings and equipment required herein shall remain the property of the Contractor. Any supplies required to maintain or operate the above listed equipment or furnishings shall be provided by the Contractor for the duration of the project.

Telephone Service: This shall consist of the installation of two (2) telephone lines: one (1) line for phone/voice service and one (1) line dedicated for the facsimile machine. The Contractor shall pay all charges except for out-of-state toll calls made by State personnel.

Data Communications Facility Wiring: Contractor shall install a Category 5e 468B patch panel in a central wiring location and Cat 5e cable from the patch panel to each PC station, terminating in a (category 5e 468B) wall or surface mount data jack. The central wiring location shall also house either the data circuit with appropriate power requirements or a category 5 cable run to the location of the installed data circuit. The central wiring location will be determined by the ConnDOT Data Center staff in coordination with the designated field office personnel as soon as the facility is in place. The ConnDOT Project Engineer will provide the Contractor with a copy of the current PC specifications, approved printer list and data wiring schematic as soon as possible after the contract is awarded.

Contractor to run a CAT 5e LAN cable a minimum length of 25 feet for each computer to LAN switch area leaving an additional 10 feet of cable length on each side with terminated RJ45 connectors. Each run / jack shall be clearly labeled with an identifying Jack Number.

The installation of a data communication circuit between the field office and the ConnDOT Data Communication Center in Newington will be coordinated between the ConnDOT District staff, ConnDOT Office of Information Systems and the local phone company. The ConnDOT District staff will coordinate the installation of the data communication service with ConnDOT PC Support once the field office phone number is issued. The Contractor shall provide the field office telephone number(s) to the ConnDOT Project Engineer as soon as possible to facilitate data line and computer installations.

Computer Hardware and Software:

The ConnDOT Project Engineer will provide the Contractor with a copy of the current PC specifications, approved printer list and data wiring schematic as soon as possible after the contract is awarded.

Before ordering the computer hardware and software, the Contractor must submit a copy of their proposed PC specifications and the type of printer to the ConnDOT Project Engineer for review by the ConnDOT Data Center. If the specification meets or exceeds the minimum specifications listed below, then the Contractor will be notified that the order may be placed.

Before any equipment is delivered to the Data Center, arrangements must be made a minimum of 24 hours in advance by contacting 860-594-3500. All software, hardware and licenses listed below shall be clearly labeled, specifying the (1) Project No., (2) Contractor Name, (3) Project Engineer's Name and (4) Project Engineer's Phone No., and shall be delivered to the ConnDOT Data Center, 2710 Berlin Turnpike, Newington, CT, where it will be configured and prepared for field installation. Installation will then be coordinated with ConnDOT field personnel and the computer system specified will be stationed in the Department's project field office.

The computer system furnished shall have all software and hardware necessary for the complete installation of the latest versions of the software listed, and therefore supplements the minimum specifications below. The Engineer reserves the right to expand or relax the specification to adapt to the software and hardware limitations and availability, the compatibility with current

agency systems, and to provide the Department with a computer system that can handle the needs of the project. This requirement is to ensure that the rapid changing environment that computer systems have experienced does not leave the needs of the project orphan to what has been specified. There will not be any price adjustment due to the change in the minimum system requirements.

The Contractor shall provide the Engineer with a licensed copy registered in the Department's name of the latest versions of the software listed and maintain customer support services offered by each software producer for the duration of the Contract. The Contractor shall deliver to the Engineer all supporting documentation for the software and hardware including any instructions or manuals. The Contractor shall provide original backup media for the software.

The Contractor shall provide the computer system with all required supplies, maintenance and repairs (including labor and parts) throughout the Contract life.

Once the Contract has been completed, the computer will remain the property of the Contractor. Prior to the return of any computer(s) to the Contractor, field personnel will coordinate with the Data Center personnel for the removal of Department owned equipment, software, data, and associated equipment.

A) <u>Computer – Minimum Specification:</u>

Processor – Intel® Core 2 Duo Processor (2.00 GHz, 800 MHz FSB 2MB L2 Cache)
Memory – 2 GB DIMM DDR2 667MHz.
Monitor – 19.0 inch LCD color monitor.
Graphics – Intel Graphics Media Accelerator 3100. or equivalent.
Hard Drive – 160 GB Ultra ATA hard drive (Western Digital, IBM or Seagate).
Floppy Drive – 3.5 inch 1.44MB diskette drive.
Optical Drive – CD-RW/DVD-RW Combo.
Multimedia Package – Integrated Sound Blaster Compatible AC97 Sound and speakers.
Case – Small Form or Mid Tower, capable of vertical or horizontal orientation.
Integrated Network Adapter – comparable to 3COM PCI 10/100 twisted pair Ethernet.
Keyboard – 104+ Keyboard.
Mouse – Optical 2-button mouse with scroll wheel.
Operating System – Windows XP Professional Service Pack 2; Windows Vista Capable.
Application Software – MS Office 2007 Professional Edition.
Additional Software (Latest Releases, including subscription services for the life of the Contract.–

- Norton Anti-Virus and CD/DVD burning software (ROXIO or NERO),
- Adobe Acrobat Standard

Resource or Driver CD/DVD – CD/DVD with all drivers and resource information so that computer can be restored to original prior to shipment back to the contractor.
Uninterrupted power supply – APC Back-UPS 500VA.

Note A1: All hardware components must be installed before delivery. All software documentation and CD-ROMs/DVD for Microsoft Windows XP Professional, Microsoft

Office 2007 Professional Edition, and other software required software must be provided. Computer Brands are limited to Dell, Gateway and HP brands only. No other brands will be accepted. The ConnDOT Project Engineer will provide the Contractor with a copy of the current PC specifications and approved printer list as soon as possible after the contract is awarded.

Note A2: As of June 30, 2008, Microsoft will no longer distribute Windows XP for retail sale, although the date for specific computer manufacturers may be different. Please consult your manufacturer for details. The Department still requires Windows XP on all PCs. Microsoft has stated that any PCs that are purchased with either Windows Vista Business, or Vista Ultimate are automatically entitled to "downgrade rights", which allow the PC to be rolled back to Windows XP. Please consult the specific manufacturer for details on downgrading new PCs to Microsoft Windows XP after June 30, 2008.

B) Laser Printer – Minimum Specification:

Print speed – 20 ppm.
Resolution – 1,200 x 1,200 dpi.
Paper size – Up to 216 mm x 355 mm (8.5 in x 14 in).
RAM – 16 MB.
Print Drivers – Must support HP PCL6 and HP PCL5e.
Printer cable – 1.8 m (6 ft).

Note B1: Laser printer brands are limited to Hewlett-Packard and Savin brands only. The ConnDOT Project Engineer will provide the Contractor with a copy of the current PC specifications and approved printer list as soon as possible after the contract is awarded.

Note B2: It is acceptable to substitute a multi-function all-in-one printer/copier/scanner/fax machine listed on the approved printer list in place of the required laser printer and fax machine.

C) Digital Camera – Minimum Specification:

Optical – 5 mega pixel, with 3x optical zoom.
Memory – 2 GB.
Features – Date/time stamp feature.
Connectivity – USB cable or memory card reader.
Software – Must be compatible with Windows XP and Vista.
Power – Rechargeable battery and charger.

The Contractor is responsible for service and repairs to all computer hardware. All repairs must be performed with-in 48 hours. If the repairs require more than a 48 hours then a replacement must be provided. All supplies, paper and maintenance for the computers, laptops, printers, copiers, and fax machines shall be provided by the Contractor.

Concrete Testing Equipment: If the Contract includes items that require compressive strength cylinders for concrete, in accordance with the Schedule of Minimum Testing Requirements for

Sampling Materials for Test, the Contractor shall provide the following. All testing equipment will remain the property of the Contractor at the completion of the project.

A) Concrete Cylinder Curing Box – meeting the requirements of Section 6.12 of the Standard Specifications.

B) Air Meter – The air meter provided shall be in good working order and will meet the requirements of AASHTO T 152.

C) Slump Cone Mold – Slump cone, base plate, and tamping rod shall be provided in like-new condition and meet the requirements of AASHTO T119, Standard Test Method for Slump of Hydraulic-Cement Concrete.

Insurance Policy: The Contractor shall provide a separate insurance policy, with no deductible, in the minimum amount of twenty thousand dollars ($20,000.00) in order to insure all State-owned data equipment and supplies used in the office against all losses. The Contractor shall be named insured on that policy, and the Department shall be an additional named insured on the policy. These losses shall include, but not be limited to: theft, fire, and physical damage. The Department will be responsible for all maintenance costs of Department owned computer hardware. In the event of loss, the Contractor shall provide replacement equipment in accordance with current Department equipment specifications, within seven days of notice of the loss. If the Contractor is unable to provide the required replacement equipment within seven days, the Department may provide replacement equipment and deduct the cost of the equipment from monies due or which may become due the Contractor under the contract or under any other contract. The Contractor's financial liability under this paragraph shall be limited to the amount of the insurance coverage required by this paragraph. If the cost of equipment replacement required by this paragraph should exceed the required amount of the insurance coverage, the Department will reimburse the Contractor for replacement costs exceeding the amount of the required coverage.

Maintenance: During the occupancy by the Department, the Contractor shall maintain all facilities and furnishings provided under the above requirements, and shall maintain and keep the office quarters clean through the use of weekly professional cleaning to include, but not limited to, washing & waxing floors, cleaning restrooms, removal of trash, etc. Exterior areas shall be mowed and clean of debris. A trash receptacle (dumpster) with weekly pickup (trash removal) shall be provided. Snow removal, sanding and salting of all parking, walkway, and entrance ways areas shall be accomplished during a storm if on a workday during work hours, immediately after a storm and prior to the start of a workday. If snow removal, salting and sanding are not completed by the specified time, the State will provide the service and all costs incurred will be deducted from the next payment estimate.

Method of Measurement: The furnishing and maintenance of the construction field office will be measured for payment by the number of calendar months that the office is in place and in operation, measured to the nearest month.

There will not be any price adjustment due to any change in the minimum computer system requirements.

Basis of Payment: The furnishing and maintenance of the construction field office will be paid at the listed unit price per month for the item "Construction Field Office, Medium", which price shall include all material, equipment, labor, utility services and work incidental thereto.

The cost of providing the parking area, external illumination, trash removal and snow and ice removal shall be included in the monthly unit price bid for the respective item "Construction Field Office, Medium".

The State will be responsible for payment of data communication user fees and for toll calls by State personnel.

Pay Item	Pay Unit
Construction Field Office, Medium	Month

ITEM #0969066A - CONSTRUCTION FIELD OFFICE, EXTRA-LARGE

Description: Under the item included in the bid document, adequate weatherproof office quarters will be provided by the Contractor for the duration of the work, and if required, for a maximum of ninety days thereafter for the exclusive use of ConnDOT forces and others who may be engaged to augment ConnDOT forces with relation to the contract. The office quarters shall be located convenient to the work site and installed in accordance with Article 1.08.02, this office shall be separated from any office occupied by the Contractor. Ownership and liability of the office quarters shall remain with the Contractor.

> **NOTE:** Due to site constraints, the construction field office will not be able to be located on the Bus Maintenance Facility Site.

Materials: Materials shall be in like new condition for the purpose intended and shall be approved by the Engineer.

Office Requirements: The Contractor shall furnish the office quarters and equipment as described below.

	Description:
2,000 SF	Sq. Ft. of floor space with a minimum ceiling height of 7 ft. and shall be partitioned as shown on building floor plan as provided by the Engineer.
2 EA	Minimum number of exterior entrances.
15 EA	Minimum number of parking spaces.

Office layout: The office shall have a minimum square footage as indicated in the table above, and shall be partitioned as shown on building floor plan as provided by the Engineer. The underside of the office shall be fully skirted to the ground.

Lavatory Facilities: The Contractor shall furnish a minimum of two (2) separate lavatories and toilet facilities ("men" and "women"), in separately enclosed rooms that are properly ventilated and comply with applicable sanitary codes. The Contractor shall provide each lavatory with hot and cold running water and flush-type toilets. He shall also supply lavatory and sanitary supplies as required.

Windows and Entrances: The windows shall be of a type that will open and close conveniently, shall be sufficient in number and size to provide adequate light and ventilation, and shall be fitted with locking devices, blinds and screens. The entrances shall be secure, screened, and fitted with a lock for which four keys shall be furnished. All keys to the construction field office shall be furnished to the Department and will be kept in their possession while State personnel are using the office. Any access to the entrance ways shall meet applicable building codes and be slip resistant, with appropriate handrails.

Lighting: The Contractor shall equip the office interior with electric lighting that provides a minimum illumination level of 100 foot-candles at desk level height, and electric outlets for each desk and drafting table. The Contractor shall also provide exterior lighting that provides a minimum

illumination level of 2 foot-candles throughout the parking area and for a minimum distance of 10 ft. on each side of the field office.
The Contractor shall provide the following additional equipment, facilities, and/or services at the Field Office on this project to include at least the following to the satisfaction of the Engineer:

Parking Facility: Adequate parking spaces with adequate illumination on a paved surface, with surface drainage if needed. If paved parking does not exist adjacent to the field office, the Contractor shall provide a parking area of sufficient size to accommodate the number of vehicles indicated in the table above. Construction of the parking area and driveway, if necessary, will consist of a minimum of 6 inches of processed aggregate base graded to drain. The base material will be extended to the office entrance.

Field Office Security: Physical Barrier Devices - This shall consist of physical means to prevent entry, such as: 1) All windows shall be barred or security screens installed; 2) All field office doors shall be equipped with dead bolt locks and regular day operated door locks; and 3) Other devices as directed by the Engineer to suit existing conditions.

Electric Service: The field office shall be equipped with an electric service panel to serve the electrical requirements of the field office, including: lighting, general outlets, computer outlets, calculators etc., and meet the following minimum specifications:

A. 120/240 volt, 1 phase, 3 wire.
B. Ampacity necessary to serve all equipment. Service shall be a minimum 100 amp dedicated to the construction field office.
C. The electrical panel shall include a main circuit breaker and branch circuit breakers of the size and quantity required.
D. Additional 120 volt, single phase, 20 amp, isolated ground dedicated power circuit with dual NEMA 5-20 receptacles will be installed at each computer workstation location.
E. Additional 120 volt, single phase, 20 amp, isolated ground dedicated power circuit with dual NEMA 5-20 receptacles will be installed, for use by the Telephone Company.
F. Additional 120-volt circuits and duplex outlets as required meeting National Electric Code requirements.
G. One exterior (outside) wall mounted GFI receptacle, duplex, isolated ground, 120 volt, straight blade.
H. After work is complete and prior to energizing, the State's ConnDOT electrical inspector, must be contacted at 860-594-2240. (Do Not Call Local Town Officials)
I. Prior to field office removal the ConnDOT Data Communications office must be notified to deactivate the communications equipment.

Heating, Ventilation and Air Conditioning (HVAC): The field office shall be equipped with sufficient heating, air conditioning and ventilation equipment to maintain a temperature range of 68°-80° Fahrenheit within the field office.

The Following Furnishings and Equipment Shall Be Provided In The Applicable Field Office Type:

QTY	Description:
8 EA	Office desks (2.5 ft x 5 ft) with drawers, locks, and matching desk chairs that have pneumatic seat height adjustment and dual wheel casters on the base.
1 EA	Standard secretarial type desk and matching desk chair that has pneumatic seat height adjustment and dual wheel casters on the base.
2 EA	Conference tables, 3 ft x12 ft.
20 EA	Office Chairs.
3 EA	Fire resistant cabinets (legal size/4 drawer), locking.
4 EA	Non-fire resistant cabinets (legal size/4 drawer), locking.
2 EA	Storage racks to hold 3 ft x 5 ft display charts.
1 EA	Mail slot bin - legal size.
2 EA	Drafting type tables (3 ft x 6 ft) and supported by wall brackets and legs; and matching drafters stool that have pneumatic seat height adjustment, seat back and dual wheel casters on the base.
1 EA	Flat file (4/drawers).
4 EA	Personal computer tables (4 ft x 2.5 ft).
1 EA	Hot and cold water dispensing unit and supply of cups and bottled water shall be supplied by the Contractor for the duration of the project.
4 EA	Electronic office type printing calculators capable of addition, subtraction, multiplication and division with memory and a supply of printing paper.
1 EA	Business telephone system for three lines with ten handsets, intercom capability, and speaker phone system for conference room.
1 EA	Telephone answering machine.
1 EA	B/W Multi-function Printer/Copier/Scanner/Fax- dry, plain paper with automatic feeder and reducing capability. All supplies, paper and maintenance shall be provided by the Contractor.
1 EA	Color Multi-function Printer/Copier/Scanner/Fax- dry, plain paper with automatic feeder and reducing capability. All supplies, paper and maintenance shall be provided by the Contractor.
9 EA	Computer systems as specified below under Computer Hardware and Software. All supplies and maintenance shall be provided by the Contractor.
1 EA	Smart Board / Projector combination – to be installed on one of the required computers in the conference room. All supplies, paper and maintenance shall be provided by the Contractor.
3 EA	Digital Camera as specified below under Computer Hardware and Software. All supplies and maintenance shall be provided by the Contractor.
2 EA	Wastebaskets - 30 gal., including plastic waste bags.
10 EA	Wastebaskets - 5 gal., including plastic waste bags.
2 EA	Electric pencil sharpeners.
2 EA	Electric wall clocks.
* EA	Fire extinguishers - provide and install type and number to meet applicable State and local codes for size of office indicated, including a fire extinguisher suitable for use on a computer terminal fire.
1 EA	Coat rack with 20 coat capacity.

QTY	Description:
1 EA	Tables - 3 ft x 6 ft.
6 EA	Interior partitions - 6 ft x 6 ft, soundproof type, portable and freestanding.
2 EA	Vertical plan racks for 2 sets of 2 ft x 3 ft plans for each rack..
2 EA	Double door supply cabinet with 4 shelves and a lock - 6 ft x 4 ft.
1 EA	Easel/chalkboard.
2 EA	Open bookcases - 3 shelves - 3 ft long.
2 EA	Infrared Thermometer, including certified calibration, case, cleaning wipes.
1 EA	Concrete Curing Box as specified below under Concrete Testing Equipment.
1 EA	Concrete Air Meter as specified below under Concrete Testing Equipment.
1 EA	Concrete Slump Cone as specified below under Concrete Testing Equipment.

The furnishings and equipment required herein shall remain the property of the Contractor. Any supplies required to maintain or operate the above listed equipment or furnishings shall be provided by the Contractor for the duration of the project.

Telephone Service: This shall consist of four (4) telephone lines: three (3) lines for phone/voice service and one (1) line dedicated for the facsimile machine. The Contractor shall pay all charges except for toll calls made by State personnel.

Data Communications Facility Wiring: Contractor shall install a Category 5e 468B patch panel in a central wiring location and Cat 5e cable from the patch panel to each networked device (includes PCs station, printer, etc.) terminating in a (category 5e 468B) wall or surface mount data jack. The central wiring location shall also house either the data circuit with appropriate power requirements or a category 5 cable run to the location of the installed data circuit. The central wiring location will be determined by the ConnDOT Data Center staff in coordination with the designated field office personnel as soon as the facility is in place. The ConnDOT Project Engineer will provide the Contractor with a copy of the current PC specifications, approved printer list and data wiring schematic as soon as possible after the contract is awarded.

Contractor to run CAT 5e LAN cables from workstations, install patch panel in data circuit demark area and terminate runs with RJ45 jacks at each computer location. Terminate runs to patch panel in LAN switch area. Each cable run / jack shall be clearly labeled with an identifying Jack Number.

The installation of a data communication circuit between the field office and the ConnDOT Data Communication Center in Newington will be coordinated between the ConnDOT District staff, ConnDOT Office of Information Systems and the local phone company. The ConnDOT District staff will coordinate the installation of the data communication service with ConnDOT PC Support once the field office phone number is issued. The Contractor shall provide the field office telephone number(s) to the ConnDOT Project Engineer as soon as possible to facilitate data line and computer installations.

Computer Hardware and Software:

The ConnDOT Project Engineer will provide the Contractor with a copy of the current PC specifications, approved printer list and data wiring schematic as soon as possible after the contract is awarded.

Before ordering the computer hardware and software, the Contractor must submit a copy of their proposed PC specifications and the type of printer to the ConnDOT Project Engineer for review by the ConnDOT Data Center. If the specification meets or exceeds the minimum specifications listed below, then the Contractor will be notified that the order may be placed.

Before any equipment is delivered to the Data Center, arrangements must be made a minimum of 24 hours in advance by contacting 860-594-3500. All software, hardware and licenses listed below shall be clearly labeled, specifying the (1) Project No., (2) Contractor Name, (3) Project Engineer's Name and (4) Project Engineer's Phone No., and shall be delivered to the ConnDOT Data Center, 2710 Berlin Turnpike, Newington, CT, where it will be configured and prepared for field installation. Installation will then be coordinated with ConnDOT field personnel and the computer system specified will be stationed in the Department's project field office.

The computer system furnished shall have all software and hardware necessary for the complete installation of the latest versions of the software listed, and therefore supplements the minimum specifications below. The Engineer reserves the right to expand or relax the specification to adapt to the software and hardware limitations and availability, the compatibility with current agency systems, and to provide the Department with a computer system that can handle the needs of the project. This requirement is to ensure that the rapid changing environment that computer systems have experienced does not leave the needs of the project orphan to what has been specified. There will not be any price adjustment due to the change in the minimum system requirements.

The Contractor shall provide the Engineer with a licensed copy registered in the Department's name of the latest versions of the software listed and maintain customer support services offered by each software producer for the duration of the Contract. The Contractor shall deliver to the Engineer all supporting documentation for the software and hardware including any instructions or manuals. The Contractor shall provide original backup media for the software.

The Contractor shall provide the computer system with all required supplies, maintenance and repairs (including labor and parts) throughout the Contract life.

Once the Contract has been completed, the computer will remain the property of the Contractor. Prior to the return of any computer(s) to the Contractor, field personnel will coordinate with the Data Center personnel for the removal of Department owned equipment, software, data, and associated equipment.

A) Computer – Minimum Specification (*revised 7-15-13):*

Processor – Intel® Core i3 Processor (2.93 GHz, 1066 MHz FSB 3MB L2 Cache) to include Intel vPro™ Technology's Advanced Management Features
Memory – 4 GB DIMM DDR3 1333MHz.
Monitors – Dual 24.0 inch LCD color monitors.
Graphics – Intel Graphics Media Accelerator 4500 or equivalent.
Hard Drive – 500 GB Ultra ATA/SATA hard drive (Western Digital, IBM or Seagate).
Optical Drive – CD-RW/DVD-RW Combo.
Multi-Card Reader – Must include SD
Multimedia Package – Integrated Sound Blaster Compatible AC97 Sound and speakers.
Case – Small Form or Mid Tower, capable of vertical or horizontal orientation.
Integrated Network Adapter – comparable to 3COM 10/100/1000 twisted pair Ethernet.
Keyboard – 104+ Keyboard.
Mouse – Optical 2-button mouse with scroll wheel.
Operating System – Windows 7 Professional.
Application Software – MS Office Professional Edition 2010.
Additional Software (Latest Releases, including subscription services for the life of the Contract) –

- Norton Anti-Virus,
- Adobe Acrobat Professional – Digital Download is not acceptable. Must be original purchased Licensed Media CD/DVD.

Resource or Driver CD/DVD – CD/DVD with all drivers and resource information so the computer can be restored to original prior to shipment back to the contractor.
Uninterrupted power supply – APC Back-UPS 500VA.

Note A1: All hardware components must be installed before delivery. All software documentation and CD-ROMs/DVD for Microsoft Windows 7 Professional, Microsoft Office 2010 Professional Edition, and other software required software must be provided. Computer Brands are limited to Dell (preferred) and HP (acceptable) brands only. No other brands will be accepted. The ConnDOT Project Engineer will provide the Contractor with a copy of the current PC specifications and approved printer list as soon as possible after the contract is awarded.

B) B/W Multi-Function Printer/Copier/Scanner/Fax – Minimum Specification:

Savin 920SPF, or other approved networked Savin multi-function on the approved list provided by the Project Engineer.
Print speed – 20 ppm.
Resolution – 1,200 x 1,200 dpi.
Paper size – 8.5in x 11in, 8.5 in x 14 in, and 11in x 17in.
RAM – 640 MB.
Print Drivers – Must support HP PCL6 and HP PCL5e.
Network interface requirements:
Network ready (MIN 10/100 RJ45)
Network/OS – Windows XP/Windows 7/Server 2008R2

Network Protocols - TCP/IP (IPv4, IPv6)
User interface - Built in display window.

Note: Before ordering the Multi-function Printer/Copier/Scanner/Fax, the Contractor must submit a copy of their proposed specifications to the ConnDOT Project Engineer for review. If the specification meets or exceeds the listed minimum specifications, then the Contractor will be notified that the order may be placed.

The Contractor is responsible for service and repairs for the Multi-function Printer/Copier/Scanner/Fax. All repairs must be performed with-in 48 hours. If the repairs require more than a 48 hours then a replacement must be provided. All supplies, paper and maintenance for the Multi-function Printer/Copier/Scanner/Fax shall be provided by the Contractor.

C) Color Multi-Function Printer/Copier/Scanner/Fax – Minimum Specification:

Savin Color Multi-function C-series, MF-series, or other approved networked color Savin multi-function on the approved list provided by the Project Engineer.
Print speed – 20 ppm.
Resolution – 1,200 x 1,200 dpi.
Paper size – 8.5in x 11in, 8.5 in x 14 in, and 11in x 17in.
RAM – 640 MB.
Print Drivers – Must support HP PCL6 and HP PCL5e.
Network interface requirements:
Network ready (MIN 10/100 RJ45)
Network/OS – Windows XP/Windows 7/Server 2008R2
Network Protocols - TCP/IP (IPv4, IPv6)
User interface - Built in display window.

Note: Before ordering the Multi-function Printer/Copier/Scanner/Fax, the Contractor must submit a copy of their proposed specifications to the ConnDOT Project Engineer for review. If the specification meets or exceeds the listed minimum specifications, then the Contractor will be notified that the order may be placed.

The Contractor is responsible for service and repairs for the Multi-function Printer/Copier/Scanner/Fax. All repairs must be performed with-in 48 hours. If the repairs require more than a 48 hours then a replacement must be provided. All supplies, paper and maintenance for the Multi-function Printer/Copier/Scanner/Fax shall be provided by the Contractor.

D) Smart Board – Minimum Specification:

Min 70in display Smart Board with integrated Projector or internal LCD or LED display– to be installed on one of the required computers in the conference room. Includes speakers and

The Contractor is responsible for service and repairs to all computer hardware. All repairs must be performed with-in 48 hours. If the repairs require more than a 48 hours then a replacement must be provided. All supplies, paper and maintenance for the computers, laptops, printers, copiers, and fax machines shall be provided by the Contractor.

E) Digital Camera – Minimum Specification:

Optical – 5 mega pixel, with 3x optical zoom.
Memory – 2 GB.
Features – Date/time stamp feature.
Connectivity – USB cable or memory card reader.
Software – Must be compatible with Windows 7.
Power – Rechargeable battery and charger.

The Contractor is responsible for service and repairs to all computer hardware. All repairs must be performed with-in 48 hours. If the repairs require more than a 48 hours then a replacement must be provided. All supplies, paper and maintenance for the computers, laptops, printers, copiers, and fax machines shall be provided by the Contractor.

Concrete Testing Equipment: If the Contract includes items that require compressive strength cylinders for concrete, in accordance with the Schedule of Minimum Testing Requirements for Sampling Materials for Test, the Contractor shall provide the following. All testing equipment will remain the property of the Contractor at the completion of the project.

A) Concrete Cylinder Curing Box – meeting the requirements of Section 6.12 of the Standard Specifications.

B) Air Meter – The air meter provided shall be in good working order and will meet the requirements of AASHTO T 152.

C) Slump Cone Mold – Slump cone, base plate, and tamping rod shall be provided in like-new condition and meet the requirements of AASHTO T119, Standard Test Method for Slump of Hydraulic-Cement Concrete.

Insurance Policy: The Contractor shall provide a separate insurance policy, with no deductible, in the minimum amount of forty thousand dollars ($40,000.00) in order to insure all State-owned data equipment and supplies used in the office against all losses. The Contractor shall be named insured on that policy, and the Department shall be an additional named insured on the policy. These losses shall include, but not be limited to: theft, fire, and physical damage. The Department will be responsible for all maintenance costs of Department owned computer hardware. In the event of loss, the Contractor shall provide replacement equipment in accordance with current Department equipment specifications, within seven days of notice of the loss. If the Contractor is unable to provide the required replacement equipment within seven days, the Department may provide replacement equipment and deduct the cost of the equipment from monies due or which may become due the Contractor under the contract or under any other contract. The Contractor's financial liability under this paragraph shall be limited to the amount of the insurance coverage

required by this paragraph. If the cost of equipment replacement required by this paragraph should exceed the required amount of the insurance coverage, the Department will reimburse the Contractor for replacement costs exceeding the amount of the required coverage.

Maintenance: During the occupancy by the Department, the Contractor shall maintain all facilities and furnishings provided under the above requirements, and shall maintain and keep the office quarters clean through the use of weekly professional cleaning to include, but not limited to, washing & waxing floors, cleaning restrooms, removal of trash, etc. Exterior areas shall be mowed and clean of debris. A trash receptacle (dumpster) with weekly pickup (trash removal) shall be provided. Snow removal, sanding and salting of all parking, walkway, and entrance ways areas shall be accomplished during a storm if on a workday during work hours, immediately after a storm and prior to the start of a workday. If snow removal, salting and sanding are not completed by the specified time, the State will provide the service and all costs incurred will be deducted from the next payment estimate.

Method of Measurement: The furnishing and maintenance of the construction field office will be measured for payment by the number of calendar months that the office is in place and in operation, measured to the nearest month.

There will not be any price adjustment due to any change in the minimum computer system requirements.

Basis of Payment: The furnishing and maintenance of the construction field office will be paid at the listed unit price per month for the respective item "Construction Field Office, Extra-Large", which price shall include all material, equipment, labor, utility services and work incidental thereto.

The cost of providing the parking area, external illumination, trash removal and snow and ice removal shall be included in the monthly unit price bid for the respective item "Construction Field Office, Extra-Large".

Pay Item	Pay Unit
Construction Field Office, Extra-Large	Month

ITEM #0970006A - TRAFFICPERSON (MUNICIPAL POLICE OFFICER)
ITEM #0970007A - TRAFFICPERSON (UNIFORMED FLAGGER)

9.70.01—Description: Under this item the Contractor shall provide the services of Trafficpersons of the type and number, and for such periods, as the Engineer approves for the control and direction of vehicular traffic and pedestrians. Traffic persons requested solely for the contractor's operational needs will not be approved for payment.

9.70.03—Construction Method: Prior to the start of operations on the project requiring the use of Trafficpersons, a meeting will be held with the Contractor, Trafficperson agency or firm, Engineer, and State Police, if applicable, to review the Trafficperson operations, lines of responsibility, and operating guidelines which will be used on the project. A copy of the municipality's billing rates for Municipal Police Officers and vehicles, if applicable, will be provided to the Engineer prior to start of work.

On a weekly basis, the Contractor shall inform the Engineer of their scheduled operations for the following week and the number of Trafficpersons requested. The Engineer shall review this schedule and approve the type and number of Trafficpersons required. In the event of an unplanned, emergency, or short term operation, the Engineer may approve the temporary use of properly clothed persons for traffic control until such time as an authorized Trafficperson may be obtained. In no case shall this temporary use exceed 8 hours for any particular operation.

If the Contractor changes or cancels any scheduled operations without prior notice of same as required by the agency providing the Trafficpersons, and such that Trafficperson services are no longer required, the Contractor will be responsible for payment at no cost to the Department of any show-up cost for any Trafficperson not used because of the change. Exceptions, as approved by the Engineer, may be granted for adverse weather conditions and unforeseeable causes beyond the control and without the fault or negligence of the Contractor.

Trafficpersons assigned to a work site are to only take direction from the Engineer.

1. Trafficpersons shall wear a high visibility safety garment that complies with OSHA, MUTCD, ASTM Standards and the safety garment shall have the words "Traffic Control" clearly visible on the front and rear panels (minimum letter size 2 inches (50 millimeters). Worn/faded safety garments that are no longer highly visible shall not be used. The Engineer shall direct the replacement of any worn/faded garment at no cost to the State.

A Trafficperson shall assist in implementing the traffic control specified in the Maintenance and Protection of Traffic contained elsewhere in these specifications or as directed by the Engineer. Any situation requiring a Trafficperson to operate in a manner contrary to the Maintenance and Protection of Traffic specification shall be authorized in writing by the Engineer.

Trafficpersons shall consist of the following types:

1. Uniformed Law Enforcement Personnel: Law enforcement personnel shall wear the high visibility safety garment provided by their law enforcement agency. If no high visibility safety garment is provided, the Contractor shall provide the law enforcement personnel with a garment meeting the requirements stated for the Uniformed Flaggers' garment.

Law Enforcement Personnel may be also be used to conduct motor vehicle enforcement operations in and around work areas as directed and approved by the Engineer.

Municipal Police Officers: Uniformed Municipal Police Officers shall be sworn Municipal Police Officers or Uniformed Constables who perform criminal law enforcement duties from the Municipality in which the project is located. Their services will also include an official Municipal Police vehicle when requested by the Engineer. Uniformed Municipal Police Officers will be used on non-limited access highways. If Uniformed Municipal Police Officers are unavailable, other Trafficpersons may be used when authorized in writing by the Engineer.
Uniformed Municipal Police Officers and requested Municipal Police vehicles will be used at such locations and for such periods as the Engineer deems necessary to control traffic operations and promote increased safety to motorists through the construction sites.

2. Uniformed Flagger: Uniformed Flaggers shall be persons who have successfully completed flagger training by the American Traffic Safety Services Association (ATSSA), National Safety Council (NSC) or other programs approved by the Engineer. A copy of the Flagger's training certificate shall be provided to the Engineer before the Flagger performs any work on the project. Uniformed Flaggers shall conform to Chapter 6E, Flagger Control, in the Manual of Uniformed Traffic Control Devices (MUTCD) and shall wear high-visibility safety apparel, use a STOP/SLOW paddle that is at least 18 inches (450 millimeters) in width with letters at least 6 inches (150 millimeters) high. The paddle shall be mounted on a pole of sufficient length to be 6 feet (1.8 meters) above the ground as measured from the bottom of the sign.

Uniformed Flaggers will only be used on non-limited access highways to control traffic operations when authorized in writing by the Engineer.

9.70.04—Method of Measurement: Services of Trafficpersons will be measured for payment by the actual number of hours for each person rendering services approved by the Engineer. These services shall include, however, only such trafficpersons as are employed within the limits of construction, project right of way of the project or along detours authorized by the Engineer to assist the motoring public through the construction work zone. Services for continued use of a detour or bypass beyond the limitations approved by the Engineer, for movement of construction vehicles and equipment, or at locations where traffic is unnecessarily restricted by the Contractor's method of operation, will not be measured for payment.

Trafficpersons shall not work more than twelve hours in any one 24 hour period. In case such services are required for more than twelve hours, additional Trafficpersons shall be furnished and measured for payment. In cases where the Trafficperson is an employee on the Contractor's

payroll, payment under the item “Trafficperson (Uniformed Flagger)” will be made only for those hours when the Contractor’s employee is performing Trafficperson services.

Travel time will not be measured for payment for services provided by Uniformed Municipal Police Officers or Uniformed Flaggers.

Mileage fees associated with Trafficperson services will not be measured for payment.

Safety garments and STOP/SLOW paddles will not be measured for payment.

9.70.05—Basis of Payment: Trafficpersons will be paid in accordance with the schedule described herein.
There will be no direct payment for safety garments or STOP/SLOW paddles. All costs associated with furnishing safety garments and STOP/SLOW paddles shall be considered included in the general cost of the item.

1. Uniformed Law Enforcement Personnel: The sum of money shown on the Estimate and in the itemized proposal as "Estimated Cost" for this work will be considered the bid price even though payment will be made as described below. The estimated cost figure is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figures will be disregarded and the original price will be used to determine the total amount for the contract.

The Department will pay the Contractor its actual costs for “Trafficperson (Municipal Police Officer)” plus an additional 5% as reimbursement for the Contractor’s administrative expense in connection with the services provided.

The invoice must include a breakdown of each officer’s actual hours of work and actual rate applied. Mileage fees associated with Trafficperson services are not reimbursable expenses and are not to be included in the billing invoice. The use of a municipal police vehicle authorized by the Engineer will be paid at the actual rate charged by the municipality. Upon receipt of the invoice from the municipality, the Contractor shall forward a copy to the Engineer. The invoice will be reviewed and approved by the Engineer prior to any payments. *Eighty (80%) of the invoice will be paid upon completion of review and approval. The balance (20%) will be paid upon receipt of cancelled check or receipted invoice, as proof of payment.* The rate charged by the municipality for use of a uniformed municipal police officer and/or a municipal police vehicle shall not be greater than the rate it normally charges others for similar services.

2. Uniformed Flagger: Uniformed flaggers will be paid for at the contract unit price per hour for “Trafficperson (Uniformed Flagger)”, which price shall include all compensation, insurance benefits and any other cost or liability incidental to the furnishing of the trafficpersons ordered.

Pay Item	Pay Unit
Trafficperson (Municipal Police Officer)	est.
Trafficperson (Uniformed Flagger)	Hr.

ITEM #0971001A – MAINTENANCE AND PROTECTION OF TRAFFIC

Article 9.71.01 – Description is supplemented by the following:

The Contractor shall maintain and protect traffic as described by the following and as limited in the Special Provision "Prosecution and Progress":

Route 262

The Contractor shall maintain and protect a minimum of one lane of traffic in each direction, each lane on a paved travel path not less than 11 feet in width.

Excepted therefrom will be those periods, during the allowable periods, when the Contractor is actively working, at which time the Contractor shall maintain and protect at least an alternating one-way traffic operation, on a paved travel path not less than 11 feet in width. The length of the alternating one-way traffic operation shall not exceed 300 feet and there shall be no more than one alternating one-way traffic operation within the project limits without prior approval of the Engineer.

Commercial and Residential Driveways

The Contractor shall maintain access to and egress from all commercial and residential driveways throughout the project limits. The Contractor will be allowed to close said driveways to perform the required work during those periods when the businesses are closed, unless permission is granted from the business owner to close the driveway during business hours. If a temporary closure of a residential driveway is necessary, the Contractor shall coordinate with the owner to determine the time period of the closure.

TRAFFIC OPERATIONS OVER RAILROAD – HIGHWAY GRADE CROSSING

The Contractor will not be allowed to queue traffic over the crossing at any point during the construction of the project. If, due to the nature of the Contractor's operations, queuing is unavoidable, the Contractor shall utilize the Railroad's Police Protection to ensure that vehicles are kept clear of the crossing area. Subject to the approval of the Railroad and the Engineer, Uniformed Flaggers and/or Town Police Officers may be used in lieu of Railroad Police Protection.

The Contractor shall coordinate its work with the Railroad's authorized representative:

Crossing #503937W
Frost Bridge Road
Watertown
Naugatuck Railroad
(860) 283-7245

Article 9.71.03 - Construction Method is supplemented as follows:

General

Unpaved travel paths will only be permitted for areas requiring full depth and full width reconstruction, in which case, the Contractor will be allowed to maintain traffic on processed aggregate for a duration not to exceed 10 calendar days. The unpaved section shall be the full width of the road and perpendicular to the travel lanes. Opposing traffic lane dividers shall be used as a centerline.

The Contractor is required to delineate any raised structures within the travel lanes, so that the structures are visible day and night, unless there are specific contract plans and provisions to temporarily lower these structures prior to the completion of work.

The Contractor shall schedule operations so that pavement removal and roadway resurfacing shall be completed full width across a roadway (bridge) section by the end of a workday (work night), or as directed by the Engineer.

When the installation of all intermediate courses of bituminous concrete pavement is completed for the entire roadway, the Contractor shall install the final course of bituminous concrete pavement.

When the Contractor is excavating adjacent to the roadway, the Contractor shall provide a 3-foot shoulder between the work area and travel lanes, with traffic drums spaced every 50 feet. At the end of the workday, if the vertical drop-off exceeds 3 inches, the Contractor shall provide a temporary traversable slope of 4:1 or flatter that is acceptable to the Engineer.

The Contractor, during the course of active construction work on overhead signs and structures, shall close the lanes directly below the work area for the entire length of time overhead work is being undertaken. At no time shall an overhead sign be left partially removed or installed.

If applicable, when an existing sign is removed, it shall be either relocated or replaced by a new sign during the same working day.

The Contractor shall not store any material on-site which would present a safety hazard to motorists or pedestrians (e.g. fixed object or obstruct sight lines).

The field installation of a signing pattern shall constitute interference with existing traffic operations and shall not be allowed, except during the allowable periods.

Construction vehicles entering travel lanes at speeds less than the posted speed are interfering with traffic, and shall not be allowed without a lane closure. The lane closure shall be of sufficient length to allow vehicles to enter or exit the work area at posted speeds, in order to merge with existing traffic.

Existing Signing

The Contractor shall maintain all existing overhead and side-mounted signs throughout the project limits during the duration of the project. The Contractor shall temporarily relocate signs and sign supports as many times as deemed necessary, and install temporary sign supports if necessary and as directed by the Engineer.

Requirements for Winter

The Contractor shall schedule a meeting with representatives from the Department including the offices of Maintenance and Traffic, and the Town/City to determine what interim traffic control measures the Contractor shall accomplish for the winter to provide safety to the motorists and permit adequate snow removal procedures. This meeting shall be held prior to October 31 of each year and will include, but not be limited to, discussion of the status and schedule of the following items: lane and shoulder widths, pavement restoration, traffic signal work, pavement markings, and signing.

Signing Patterns

The Contractor shall erect and maintain all signing patterns in accordance with the traffic control plans contained herein. Proper distances between advance warning signs and proper taper lengths are mandatory.

Pavement Markings -Non-Limited Access Multilane Roadways
Secondary and Local Roadways
During construction, the Contractor shall maintain all pavement markings on paved surfaces on all roadways throughout the limits of the project.

Interim Pavement Markings
The Contractor shall install painted pavement markings, which shall include centerlines, shoulder edge lines, lane lines (broken lines), lane-use arrows, and stop bars, on each intermediate course of bituminous concrete pavement and on any milled surface by the end of the work day/night. If the next course of bituminous concrete pavement will be placed within seven days, shoulder edge lines are not required. The painted pavement markings will be paid under the appropriate items.

If the Contractor will install another course of bituminous concrete pavement within 24 hours, the Contractor may install Temporary Plastic Pavement Marking Tape in place of the painted pavement markings by the end of the work day/night. These temporary pavement markings shall include centerlines, lane lines (broken lines) and stop bars; shoulder edge lines are not required. Centerlines shall consist of two 4 inch wide yellow markings, 2 feet in length, side by side, 4 to 6 inches apart, at 40-foot intervals. No passing zones should be posted with signs in those areas where the final centerlines have not been established on two-way roadways. Stop bars may consist of two 6 inch wide white markings or three 4 inch wide white markings placed side by side. The Contractor shall remove and dispose of the Temporary Plastic Pavement Marking Tape when another course of bituminous concrete pavement is installed. The cost of furnishing,

installing and removing the Temporary Plastic Pavement Marking Tape shall be at the Contractor's expense.

If an intermediate course of bituminous concrete pavement will be exposed throughout the winter, then Epoxy Resin Pavement Markings should be installed unless directed otherwise by the Engineer.

Final Pavement Markings

The Contractor should install painted pavement markings on the final course of bituminous concrete pavement by the end of the work day/night. If the painted pavement markings are not installed by the end of the work day/night, then Temporary Plastic Pavement Marking Tape shall be installed as described above and the painted pavement markings shall be installed by the end of the work day/night on Friday of that week.

If Temporary Plastic Pavement Marking Tape is installed, the Contractor shall remove and dispose of these markings when the painted pavement markings are installed. The cost of furnishing, installing and removing the Temporary Plastic Pavement Marking Tape shall be at the Contractor's expense.

The Contractor shall install permanent Epoxy Resin Pavement Markings in accordance with Section 12.10 entitled "Epoxy Resin Pavement Markings, Symbols, and Legends" after such time as determined by the Engineer.

TRAFFIC CONTROL DURING CONSTRUCTION OPERATIONS

The following guidelines shall assist field personnel in determining when and what type of traffic control patterns to use for various situations. These guidelines shall provide for the safe and efficient movement of traffic through work zones and enhance the safety of work forces in the work area.

TRAFFIC CONTROL PATTERNS

Traffic control patterns shall be used when a work operation requires that all or part of any vehicle or work area protrudes onto any part of a travel lane or shoulder. For each situation, the installation of traffic control devices shall be based on the following:

Speed and volume of traffic
Duration of operation
Exposure to hazards

Traffic control patterns shall be uniform, neat and orderly so as to command respect from the motorist.

In the case of a horizontal or vertical sight restriction in advance of the work area, the traffic control pattern shall be extended to provide adequate sight distance for approaching traffic.

If a lane reduction taper is required to shift traffic, the entire length of the taper should be installed on a tangent section of roadway so that the entire taper area can be seen by the motorist.

Any existing signs that are in conflict with the traffic control patterns shall be removed, covered, or turned so that they are not readable by oncoming traffic.

When installing a traffic control pattern, a Buffer Area should be provided and this area shall be free of equipment, workers, materials and parked vehicles.

Typical traffic control plans 19 through 25 may be used for moving operations such as line striping, pot hole patching, mowing, or sweeping when it is necessary for equipment to occupy a travel lane.

Traffic control patterns will not be required when vehicles are on an emergency patrol type activity or when a short duration stop is made and the equipment can be contained within the shoulder. Flashing lights and appropriate trafficperson shall be used when required.

Although each situation must be dealt with individually, conformity with the typical traffic control plans contained herein is required. In a situation not adequately covered by the typical traffic control plans, the Contractor must contact the Engineer for assistance prior to setting up a traffic control pattern.

PLACEMENT OF SIGNS

Signs must be placed in such a position to allow motorists the opportunity to reduce their speed prior to the work area. Signs shall be installed on the same side of the roadway as the work area. On multi-lane divided highways, advance warning signs shall be installed on both sides of the highway. On directional roadways (on-ramps, off-ramps, one-way roads), where the sight distance to signs is restricted, these signs should be installed on both sides of the roadway.

ALLOWABLE ADJUSTMENT OF SIGNS AND DEVICES SHOWN ON THE TRAFFIC CONTROL PLANS

The traffic control plans contained herein show the location and spacing of signs and devices under ideal conditions. Signs and devices should be installed as shown on these plans whenever possible.

The proper application of the traffic control plans and installation of traffic control devices depends on actual field conditions.

Adjustments to the traffic control plans shall be made only at the direction of the Engineer to improve the visibility of the signs and devices and to better control traffic operations. Adjustments to the traffic control plans shall be based on safety of work forces and motorists, abutting property requirements, driveways, side roads, and the vertical and horizontal curvature of the roadway.

The Engineer may require that the traffic control pattern be located significantly in advance of the work area to provide better sight line to the signing and safer traffic operations through the work zone.

Table I indicates the minimum taper length required for a lane closure based on the posted speed limit of the roadway. These taper lengths shall only be used when the recommended taper lengths shown on the traffic control plans cannot be achieved.

TABLE I – MINIMUM TAPER LENGTHS

POSTED SPEED LIMIT MILES PER HOUR	MINIMUM TAPER LENGTH IN FEET FOR A SINGLE LANE CLOSURE
30 OR LESS	180
35	250
40	320
45	540
50	600
55	660
65	780

SECTION 1. WORK ZONE SAFETY MEETINGS

1.a) Prior to the commencement of work, a work zone safety meeting will be conducted with representatives of DOT Construction, Connecticut State Police (Local Barracks), Municipal Police, the Contractor (Project Superintendent) and the Traffic Control Subcontractor (if different than the prime Contractor) to review the traffic operations, lines of responsibility, and operating guidelines which will be used on the project. Other work zone safety meetings during the course of the project should be scheduled as needed.

1.b) A Work Zone Safety Meeting Agenda shall be developed and used at the meeting to outline the anticipated traffic control issues during the construction of this project. Any issues that can't be resolved at these meetings will be brought to the attention of the District Engineer and the Office of Construction. The agenda should include:

- Review Project scope of work and time
- Review Section 1.08, Prosecution and Progress
- Review Section 9.70, Trafficpersons
- Review Section 9.71, Maintenance and Protection of Traffic
- Review Contractor's schedule and method of operations.
- Review areas of special concern: ramps, turning roadways, medians, lane drops, etc.
- Open discussion of work zone questions and issues
- Discussion of review and approval process for changes in contract requirements as they relate to work zone areas

SECTION 2. GENERAL

2.a) If the required minimum number of signs and equipment (i.e. one High Mounted Internally Illuminated Flashing Arrow for each lane closed, two TMAs, Changeable Message Sign, etc.) are not available; the traffic control pattern shall not be installed.

2.b) The Contractor shall have back-up equipment (TMAs, High Mounted Internally Illuminated Flashing Arrow, Changeable Message Sign, construction signs, cones/drums, etc.) available at all times in case of mechanical failures, etc. The only exception to this is in the case of sudden equipment breakdowns in which the pattern may be installed but the Contractor must provide replacement equipment within 24 hours.

2.c) Failure of the Contractor to have the required minimum number of signs, personnel and equipment, which results in the pattern not being installed, shall not be a reason for a time extension or claim for loss time.

2.d) In cases of legitimate differences of opinion between the Contractor and the Inspection staff, the Inspection staff shall err on the side of safety. The matter shall be brought to the District Office for resolution immediately or, in the case of work after regular business hours, on the next business day.

SECTION 3. INSTALLING AND REMOVING TRAFFIC CONTROL PATTERNS

3.a) Lane Closures shall be installed beginning with the advanced warning signs and proceeding forward toward the work area.

3.b) Lane Closures shall be removed in the reverse order, beginning at the work area, or end of the traffic control pattern, and proceeding back toward the advanced warning signs.

3.c) Stopping traffic may be allowed:

- As per the contract for such activities as blasting, steel erection, etc.
- During paving, milling operations, etc. where, in the middle of the operation, it is necessary to flip the pattern to complete the operation on the other half of the roadway and traffic should not travel across the longitudinal joint or difference in roadway elevation.
- To move slow moving equipment across live traffic lanes into the work area.

3.d) Under certain situations when the safety of the traveling public and/or that of the workers may be compromised due to conditions such as traffic volume, speed, roadside obstructions, or sight line deficiencies, as determined by the Engineer and/or State Police, traffic may be briefly impeded while installing and/or removing the advanced warning signs and the first ten traffic cones/drums only. Appropriate measures shall be taken to safely slow traffic. If required, traffic slowing techniques may be used and shall include the use of Truck Mounted Impact Attenuators (TMAs) as appropriate, for a minimum of one mile in advance of the pattern starting point. Once the advanced warning signs and the first ten traffic cones/drums are installed/removed, the TMAs and sign crew shall continue to install/remove the pattern as described in Section 4c and traffic shall be allowed to resume their normal travel.

3.e) The Contractor must adhere to using the proper signs, placing the signs correctly, and ensuring the proper spacing of signs.

3.f) Additional devices are required on entrance ramps, exit ramps, and intersecting roads to warn and/or move traffic into the proper travelpath prior to merging/exiting with/from the main line traffic. This shall be completed before installing the mainline pattern past the ramp or intersecting roadway.

3.g) Prior to installing a pattern, any conflicting existing signs shall be covered with an opaque material. Once the pattern is removed, the existing signs shall be uncovered.

3.h) On limited access roadways, workers are prohibited from crossing the travel lanes to install and remove signs or other devices on the opposite side of the roadway. Any signs or devices on the opposite side of the roadway shall be installed and removed separately.

SECTION 4. USE OF HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

4.a) On limited access roadways, one Flashing Arrow shall be used for each lane that is closed. The Flashing Arrow shall be installed concurrently with the installation of the traffic control pattern and its placement shall be as shown on the traffic control plan. For multiple lane closures, one Flashing Arrow is required for each lane closed. If conditions warrant, additional Flashing Arrows should be employed (i.e.: curves, major ramps, etc.).

4.b) On non-limited access roadways, the use of a Flashing Arrow for lane closures is optional. The roadway geometry, sight line distance, and traffic volume should be considered in the decision to use the Flashing Arrow.

4.c) The Flashing Arrow shall not be used on two lane, two-way roadways for temporary alternating one-way traffic operations.

4.d) The Flashing Arrow board display shall be in the "arrow" mode for lane closure tapers and in the "caution" mode (four corners) for shoulder work, blocking the shoulder, or roadside work near the shoulder. The Flashing Arrow shall be in the "caution" mode when it is positioned in the closed lane.

4.e) The Flashing Arrow shall not be used on a multi-lane roadway to laterally shift all lanes of traffic, because unnecessary lane changing may result.

SECTION 5. USE OF TRUCK MOUNTED IMPACT ATTENUATOR VEHICLES (TMAs)

5.a) For lane closures on limited access roadways, a minimum of two TMAs shall be used to install and remove traffic control patterns. If two TMAs are not available, the pattern shall not be installed.

5.b) On non-limited access roadways, the use of TMAs to install and remove patterns closing a lane(s) is optional. The roadway geometry, sight line distance, and traffic volume should be considered in the decision to utilize the TMAs.

5.c) Generally, to establish the advance and transition signing, one TMA shall be placed on the shoulder and the second TMA shall be approximately 1,000 feet ahead blocking the lane. The flashing arrow board mounted on the TMA should be in the "flashing arrow" mode when taking the lane. The sign truck and workers should be immediately ahead of the second TMA. In no case shall the TMA be used as the sign truck or a work truck. Once the transition is in place, the TMAs shall travel in the closed lane until all Changeable Message Signs, signs, Flashing Arrows, and cones/drums are installed. The flashing arrow board mounted on the TMA should be in the "caution" mode when traveling in the closed lane.

5.d) A TMA shall be placed prior to the first work area in the pattern. If there are multiple work areas within the same pattern, then additional TMAs shall be positioned at each additional work area as needed. The flashing arrow board mounted on the TMA should be in the "caution" mode when in the closed lane.

5.e) TMAs shall be positioned a sufficient distance prior to the workers or equipment being protected to allow for appropriate vehicle roll-ahead in the event that the TMA is hit, but not so far that an errant vehicle could travel around the TMA and into the work area. For additional placement and use details, refer to the specification entitled "Type 'D' Portable Impact Attenuation System". Some operations, such as paving and concrete repairs, do not allow for placement of the TMA(s) within the specified distances. In these situations, the TMA(s) should be placed at the beginning of the work area and shall be advanced as the paving or concrete operations proceed.

5.f) TMAs should be paid in accordance with how the unit is utilized. When it is used as a TMA and is in the proper location as specified, and then it should be paid at the specified hourly rate for "Type 'D' Portable Impact Attenuation System". When the TMA is used as a Flashing Arrow, it should be paid at the daily rate for "High Mounted Internally Illuminated Flashing Arrow". If a TMA is used to install and remove a pattern and then is used as a Flashing Arrow, the unit should be paid as a "Type 'D' Portable Impact Attenuation System" for the hours used to install and remove the pattern, typically 2 hours (1 hour to install and 1 hour to remove), and is also paid for the day as a "High Mounted Internally Illuminated Flashing Arrow".

SECTION 6. USE OF TRAFFIC DRUMS AND TRAFFIC CONES

6.a) Traffic drums shall be used for taper channelization on limited-access roadways, ramps, and turning roadways and to delineate raised catch basins and other hazards.

6.b) Traffic drums shall be used in place of traffic cones in traffic control patterns that are in effect for more than a 36-hour duration.

6.c) Traffic Cones less than 42 inches in height shall not be used on limited-access roadways or on non-limited access roadways with a posted speed limit of 45 mph and above.

6.d) Typical spacing of traffic drums and/or cones shown on the Traffic Control Plans in the Contract are maximum spacings and may be reduced to meet actual field conditions as required.

SECTION 7. USE OF (REMOTE CONTROLLED) CHANGEABLE MESSAGE SIGNS (CMS)

7.a) For lane closures on limited access roadways, one CMS shall be used in advance of the traffic control pattern. Prior to installing the pattern, the CMS shall be installed and in operation, displaying the appropriate lane closure information (i.e.: Left Lane Closed -

Merge Right). The CMS shall be positioned ½ - 1 mile ahead of the lane closure taper. If the nearest Exit ramp is greater than the specified ½ - 1 mile distance, than an additional CMS shall be positioned a sufficient distance ahead of the Exit ramp to alert motorists to the work and therefore offer them an opportunity to take the exit.

7.b) CMS should not be installed within 1000 feet of an existing CMS.

7.c) On non-limited access roadways, the use of CMS for lane closures is optional. The roadway geometry, sight line distance, and traffic volume should be considered in the decision to use the CMS.

7.d) The advance CMS is typically placed off the right shoulder, 5 feet from the edge of pavement. In areas where the CMS cannot be placed beyond the edge of pavement, it may be placed on the paved shoulder with a minimum of five (5) traffic drums placed in a taper in front of it to delineate its position. The advance CMS shall be adequately protected if it is used for a continuous duration of 36 hours or more.

7.e) When the CMS are no longer required, they should be removed from the clear zone and have the display screen cleared and turned 90° away from the roadway.

7.f) The CMS generally should not be used for generic messages (ex: Road Work Ahead, Bump Ahead, Gravel Road, etc.).

7.g) The CMS should be used for specific situations that need to command the motorist's attention which cannot be conveyed with standard construction signs (Examples include: Exit 34 Closed Sat/Sun - Use Exit 35, All Lanes Closed - Use Shoulder, Workers on Road - Slow Down).

7.h) Messages that need to be displayed for long periods of time, such as during stage construction, should be displayed with construction signs. For special signs, please coordinate with the Office of Construction and the Division of Traffic Engineering for the proper layout/dimensions required.

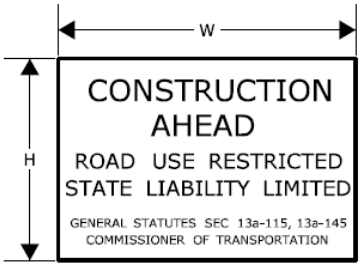
7.i) The messages that are allowed on the CMS are as follows:

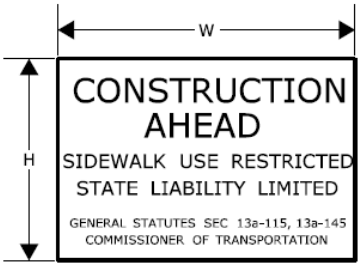
Message No.	Frame 1	Frame 2	Message No.	Frame 1	Frame 2
1	LEFT LANE CLOSED	MERGE RIGHT	9	LANES CLOSED AHEAD	REDUCE SPEED
2	2 LEFT LANES CLOSED	MERGE RIGHT	10	LANES CLOSED AHEAD	USE CAUTION

3	LEFT LANE CLOSED	REDUCE SPEED	11	WORKERS ON ROAD	REDUCE SPEED
4	2 LEFT LANES CLOSED	REDUCE SPEED	12	WORKERS ON ROAD	SLOW DOWN
5	RIGHT LANE CLOSED	MERGE LEFT	13	EXIT XX CLOSED	USE EXIT YY
6	2 RIGHT LANES CLOSED	MERGE LEFT	14	EXIT XX CLOSED USE YY	FOLLOW DETOUR
7	RIGHT LANE CLOSED	REDUCE SPEED	15	2 LANES SHIFT AHEAD	USE CAUTION
8	2 RIGHT LANES CLOSED	REDUCE SPEED	16	3 LANES SHIFT AHEAD	USE CAUTION

For any other message(s), approval must be received from the Office of Construction prior to their use. No more than two (2) displays shall be used within any message cycle.

SERIES 16 SIGNS





		W H
16-E	80-1605	84" x 60"
16-H	80-1608	60" x 42"
16-M	80-1613	30" x 24"

		W H
16-S	80-1619	48" x 30"

THE 16-S SIGN SHALL BE USED ON ALL PROJECTS THAT REQUIRE SIDEWALK RECONSTRUCTION OR RESTRICT PEDESTRIAN TRAVEL ON AN EXISTING SIDEWALK.

SERIES 16 SIGNS SHALL BE INSTALLED IN ADVANCE OF THE TRAFFIC CONTROL PATTERNS TO ALLOW MOTORISTS THE OPPORTUNITY TO AVOID A WORK ZONE. SERIES 16 SIGNS SHALL BE INSTALLED ON ANY MAJOR INTERSECTING ROADWAYS THAT APPROACH THE WORK ZONE. ON LIMITED-ACCESS HIGHWAYS, THESE SIGNS SHALL BE LOCATED IN ADVANCE OF THE NEAREST UPSTREAM EXIT RAMP AND ON ANY ENTRANCE RAMPS PRIOR TO OR WITHIN THE WORK ZONE LIMITS.

THE LOCATION OF SERIES 16 SIGNS CAN BE FOUND ELSEWHERE IN THE PLANS OR INSTALLED AS DIRECTED BY THE ENGINEER.

SIGNS 16-E AND 16-H SHALL BE POST-MOUNTED.

SIGN 16-E SHALL BE USED ON ALL EXPRESSWAYS.

SIGN 16-H SHALL BE USED ON ALL RAMPS, OTHER STATE ROADWAYS, AND MAJOR TOWN/CITY ROADWAYS.

SIGN 16-M SHALL BE USED ON OTHER TOWN ROADWAYS.

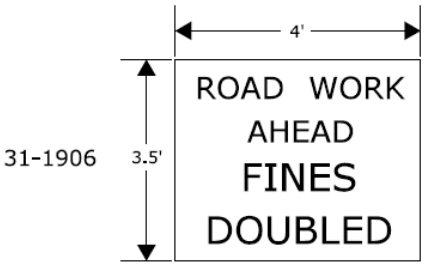
REGULATORY SIGN "ROAD WORK AHEAD, FINES DOUBLED"

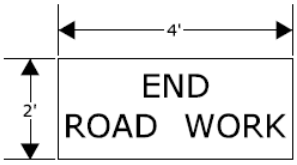
THE REGULATORY SIGN "ROAD WORK AHEAD FINES DOUBLED" SHALL BE INSTALLED FOR ALL WORK ZONES THAT OCCUR ON ANY STATE HIGHWAY IN CONNECTICUT WHERE THERE ARE WORKERS ON THE HIGHWAY OR WHEN THERE IS OTHER THAN EXISTING TRAFFIC OPERATIONS.

THE "ROAD WORK AHEAD FINES DOUBLED" REGULATORY SIGN SHALL BE PLACED AFTER THE SERIES 16 SIGN AND IN ADVANCE OF THE "ROAD WORK AHEAD" SIGN.

"END ROAD WORK" SIGN

THE LAST SIGN IN THE PATTERN MUST BE THE "END ROAD WORK" SIGN.





SCALE: NONE

CONSTRUCTION TRAFFIC CONTROL PLAN

REQUIRED SIGNS

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED Charles S. Harlow 2012.06.05 11:35:43-04'00'
PRINCIPAL ENGINEER

NOTES FOR TRAFFIC CONTROL PLANS

1. IF A TRAFFIC STOPPAGE OCCURS IN ADVANCE OF SIGN (A), THEN AN ADDITIONAL SIGN (A) SHALL BE INSTALLED IN ADVANCE OF THE STOPPAGE.

2. SIGNS (AA), (A), AND (D) SHOULD BE OMITTED WHEN THESE SIGNS HAVE ALREADY BEEN INSTALLED TO DESIGNATE A LARGER WORK ZONE THAN THE WORK ZONE THAT IS ENCOMPASSED ON THIS PLAN.

3. SEE TABLE 1 FOR ADJUSTMENT OF TAPERS IF NECESSARY.

4. IF THIS PLAN REMAINS IN CONTINUOUS OPERATION FOR MORE THAN 36 HOURS, THEN TRAFFIC DRUMS SHALL BE USED IN PLACE OF TRAFFIC CONES.

5. ANY LEGAL SPEED LIMIT SIGNS WITHIN THE LIMITS OF A ROADWAY / LANE CLOSURE AREA SHALL BE COVERED WITH AN OPAQUE MATERIAL WHILE THE CLOSURE IS IN EFFECT, AND UNCOVERED WHEN THE ROADWAY / LANE CLOSURE IS RE-OPENED TO ALL LANES OF TRAFFIC.

6. IF THIS PLAN REMAINS IN CONTINUOUS OPERATION FOR MORE THAN 36 HOURS, THEN ANY EXISTING CONFLICTING PAVEMENT MARKINGS SHALL BE ERADICATED OR COVERED, AND TEMPORARY PAVEMENT MARKINGS THAT DELINEATE THE PROPER TRAVELPATHS SHALL BE INSTALLED.

7. DISTANCES BETWEEN SIGNS IN THE ADVANCE WARNING AREA MAY BE REDUCED TO 100' ON LOW-SPEED URBAN ROADS (SPEED LIMIT < 40 MPH).

8. IF THIS PLAN IS TO REMAIN IN OPERATION DURING THE HOURS OF DARKNESS, INSTALL BARRICADE WARNING LIGHTS - HIGH INTENSITY ON ALL POST-MOUNTED DIAMOND SIGNS IN THE ADVANCE WARNING AREA.

9. A CHANGEABLE MESSAGE SIGN SHALL BE INSTALLED ONE HALF TO ONE MILE IN ADVANCE OF THE LANE CLOSURE TAPER.

10 SIGN (P) SHALL BE MOUNTED A MINIMUM OF 7 FEET FROM THE PAVEMENT SURFACE TO THE BOTTOM OF THE SIGN.

TABLE 1 - MINIMUM TAPER LENGTHS

POSTED SPEED LIMIT (MILES PER HOUR)	MINIMUM TAPER LENGTH FOR A SINGLE LANE CLOSURE
30 OR LESS	180' (55m)
35	250' (75m)
40	320' (100m)
45	540' (165m)
50	600' (180m)
55	660' (200m)
65	780' (240m)

METRIC CONVERSION CHART (1" = 25mm)

ENGLISH	METRIC	ENGLISH	METRIC	ENGLISH	METRIC
12"	300mm	42"	1050mm	72"	1800mm
18"	450mm	48"	1200mm	78"	1950mm
24"	600mm	54"	1350mm	84"	2100mm
30"	750mm	60"	1500mm	90"	2250mm
36"	900mm	66"	1650mm	96"	2400mm

SCALE: NONE

CONSTRUCTION TRAFFIC CONTROL PLAN

NOTES

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

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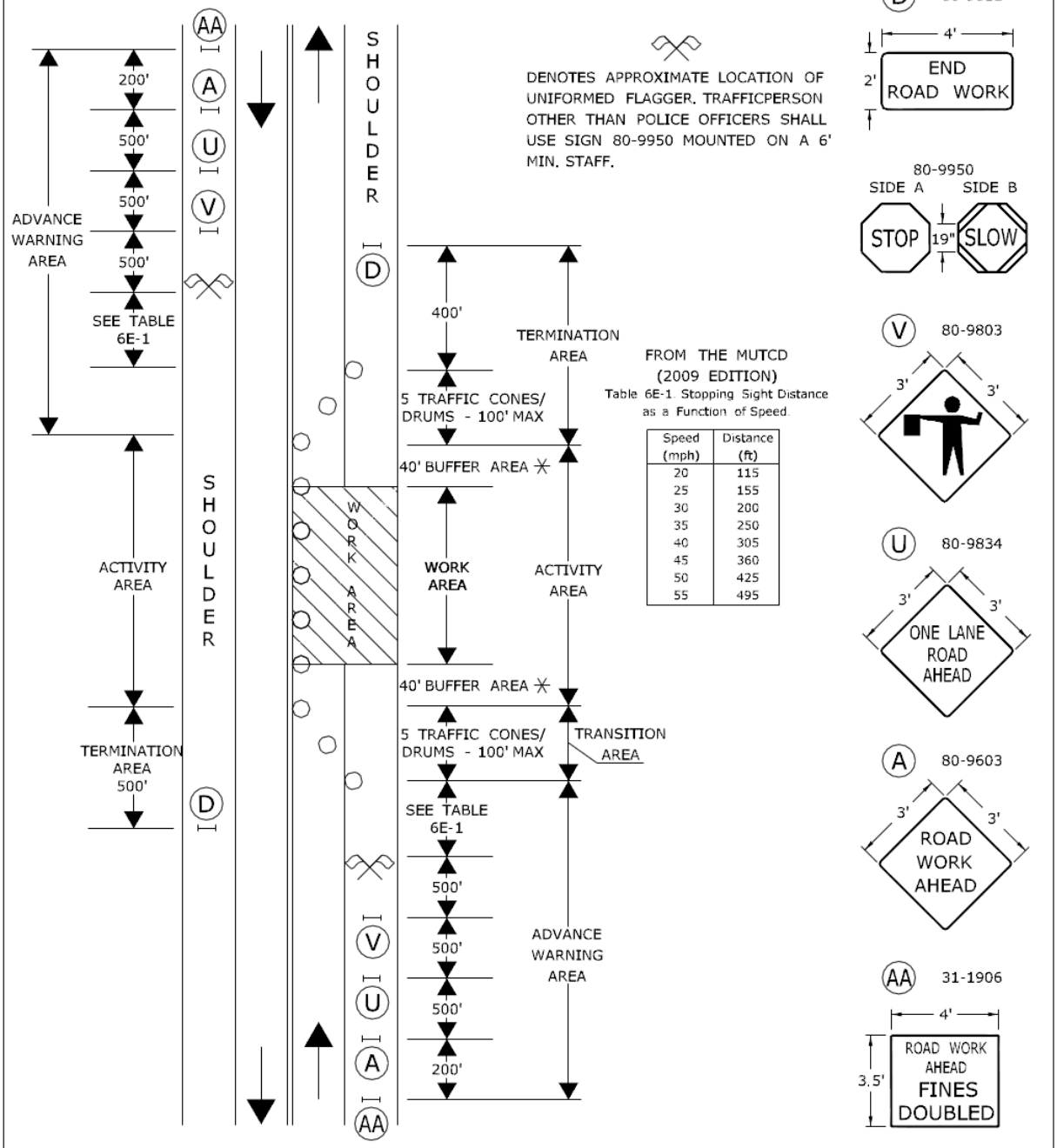
PRINCIPAL ENGINEER

WORK IN TRAVEL LANE AND SHOULDER
TWO LANE HIGHWAY
ALTERNATING ONE-WAY TRAFFIC OPERATIONS

SIGN FACE
108 SQ. FT (MIN.)



FROM THE MUTCD
(2009 EDITION)
Table 6E-1 Stopping Sight Distance as a Function of Speed

Speed (mph)	Distance (ft)
20	115
25	155
30	200
35	250
40	305
45	360
50	425
55	495

○ TRAFFIC CONE **OR** TRAFFIC DRUM
✳ OPTIONAL ⊗ TRAFFIC DRUM ⊢⊣ PORTABLE SIGN SUPPORT
⇦ HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

SCALE: NONE

CONSTRUCTION TRAFFIC CONTROL PLAN
PLAN 13 - SHEET 1 OF 2
SEE NOTES 1, 2, 4, 6, 7, 8

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED Charles S. Harlow 2012.06.05 15:55:23-04'00'
PRINCIPAL ENGINEER

WORK IN TRAVEL LANE AND SHOULDER
TWO LANE HIGHWAY
ALTERNATING ONE-WAY TRAFFIC OPERATIONS

SIGN FACE
108 SQ. FT (MIN.)

HAND SIGNAL METHODS TO BE USED BY UNIFORMED FLAGGERS

THE FOLLOWING METHODS FROM SECTION 6E.07, FLAGGER PROCEDURES, IN THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES," SHALL BE USED BY UNIFORMED FLAGGERS WHEN DIRECTING TRAFFIC THROUGH A WORK AREA. THE STOP/SLOW SIGN PADDLE (SIGN NO. 80-9950) SHOWN ON THE TRAFFIC STANDARD SHEET TR-1220 01 ENTITLED, "SIGNS FOR CONSTRUCTION AND PERMIT OPERATIONS" SHALL BE USED.

A. TO STOP TRAFFIC

TO STOP ROAD USERS, THE FLAGGER SHALL FACE ROAD USERS AND AIM THE STOP PADDLE FACE TOWARD ROAD USERS IN A STATIONARY POSITION WITH THE ARM EXTENDED HORIZONTALLY AWAY FROM THE BODY. THE FREE ARM SHALL BE HELD WITH THE PALM OF THE HAND ABOVE SHOULDER LEVEL TOWARD APPROACHING TRAFFIC.

B. TO DIRECT TRAFFIC TO PROCEED

TO DIRECT STOPPED ROAD USERS TO PROCEED, THE FLAGGER SHALL FACE ROAD USERS WITH THE SLOW PADDLE FACE AIMED TOWARD ROAD USERS IN A STATIONARY POSITION WITH THE ARM EXTENDED HORIZONTALLY AWAY FROM THE BODY. THE FLAGGER SHALL MOTION WITH THE FREE HAND FOR ROAD USERS TO PROCEED.

C. TO ALERT OR SLOW TRAFFIC

TO ALERT OR SLOW TRAFFIC, THE FLAGGER SHALL FACE ROAD USERS WITH THE SLOW PADDLE FACE AIMED TOWARD ROAD USERS IN A STATIONARY POSITION WITH THE ARM EXTENDED HORIZONTALLY AWAY FROM THE BODY. TO FURTHER ALERT OR SLOW TRAFFIC, THE FLAGGER HOLDING THE SLOW PADDLE FACE TOWARD ROAD USERS MAY MOTION UP AND DOWN WITH THE FREE HAND, PALM DOWN.

◯ TRAFFIC CONE **OR** TRAFFIC DRUM
✳ OPTIONAL ⊗ TRAFFIC DRUM ⊢⊣ PORTABLE SIGN SUPPORT
⇦ HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

SCALE: NONE

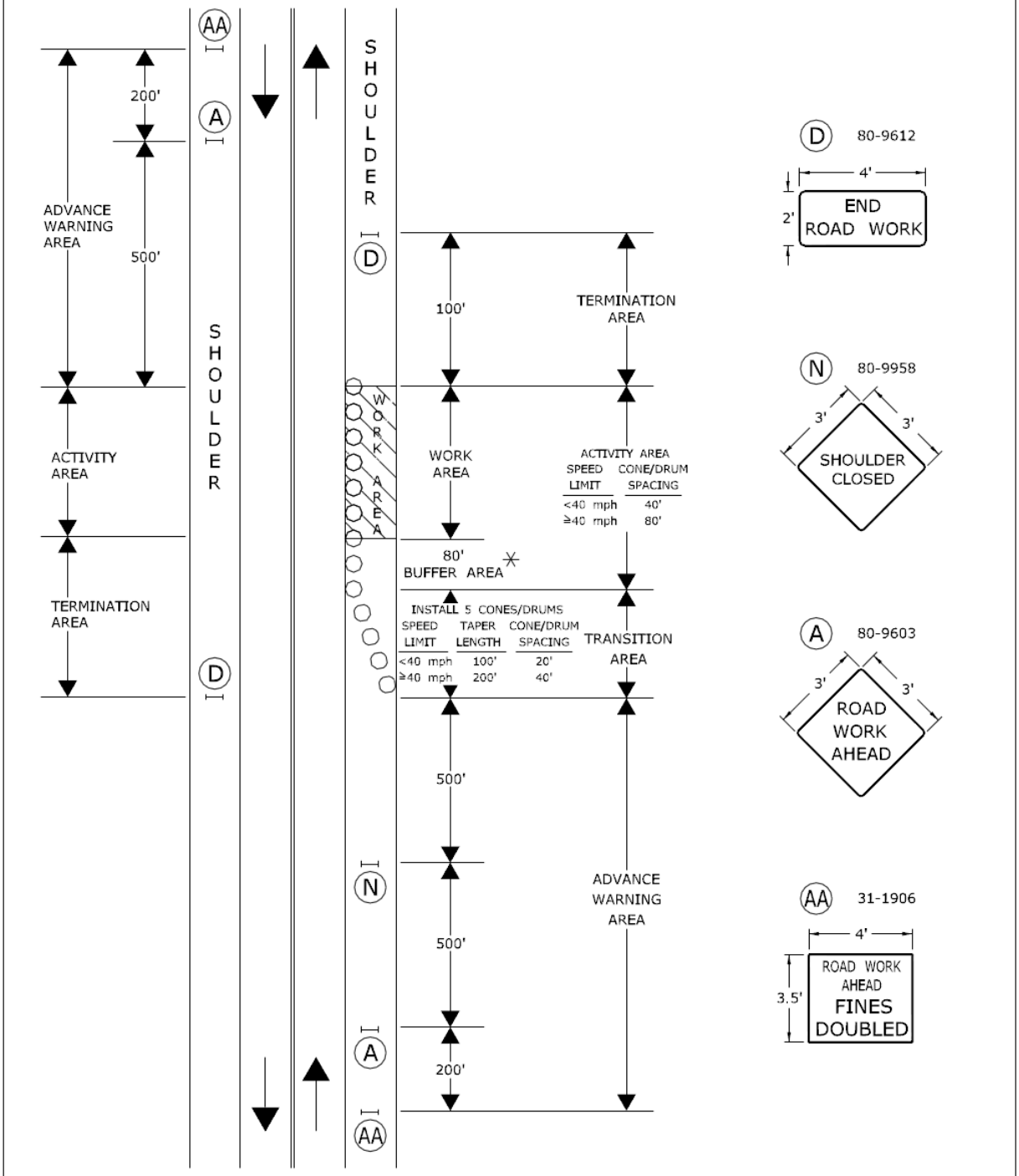
CONSTRUCTION TRAFFIC CONTROL PLAN
PLAN 13 - SHEET 2 OF 2
SEE NOTES 1, 2, 4, 6, 7, 8

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED Charles S. Harlow 2012.06.05 15:55:45-04'00'
PRINCIPAL ENGINEER

WORK IN SHOULDER - TWO LANE HIGHWAY

SIGN FACE
71 SQ. FT (MIN.)



TRAFFIC CONE **OR** TRAFFIC DRUM
OPTIONAL TRAFFIC DRUM PORTABLE SIGN SUPPORT
HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

SCALE: NONE

CONSTRUCTION TRAFFIC CONTROL PLAN

PLAN 14

SEE NOTES 1, 2, 4, 7, 8

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

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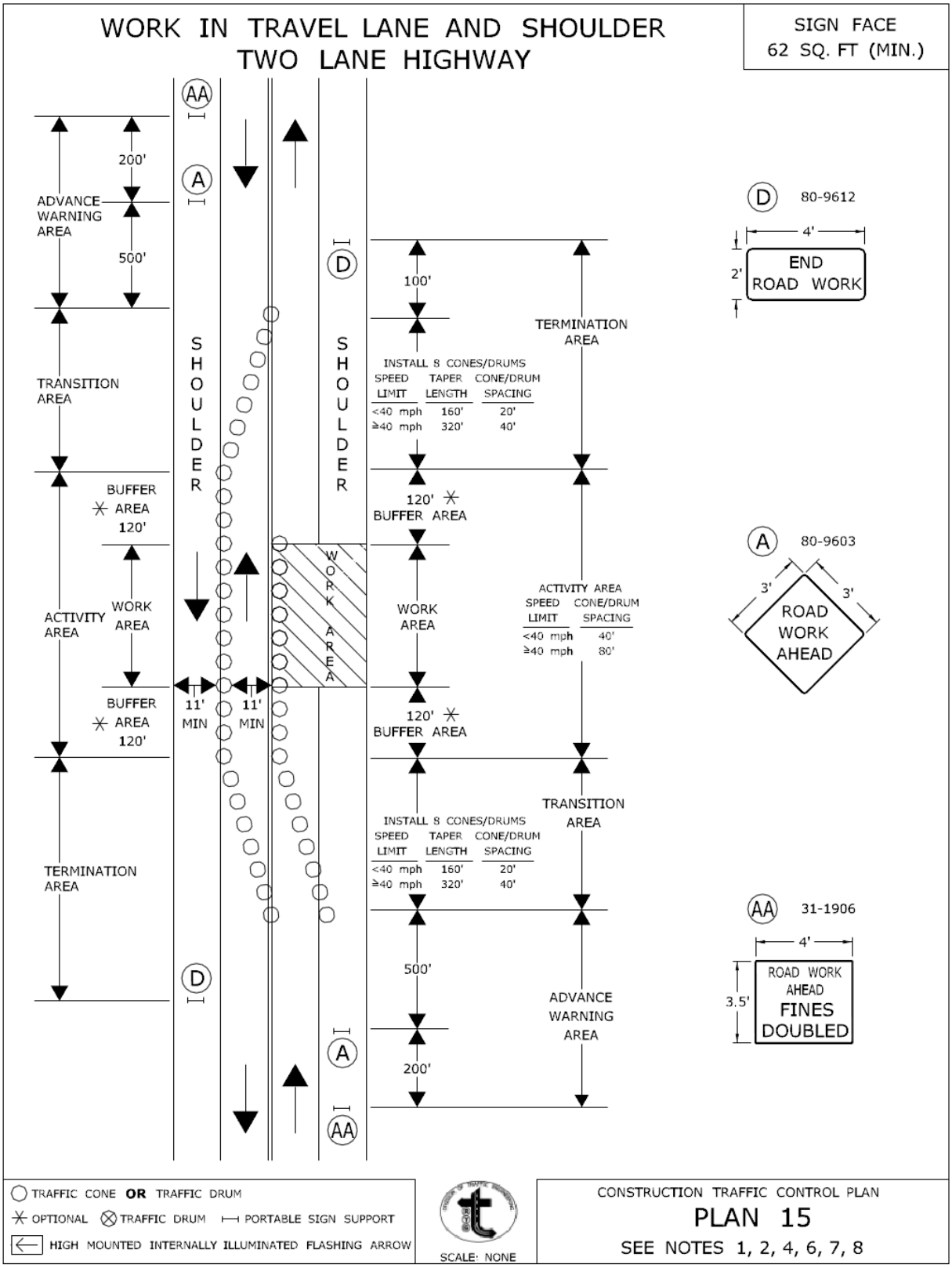
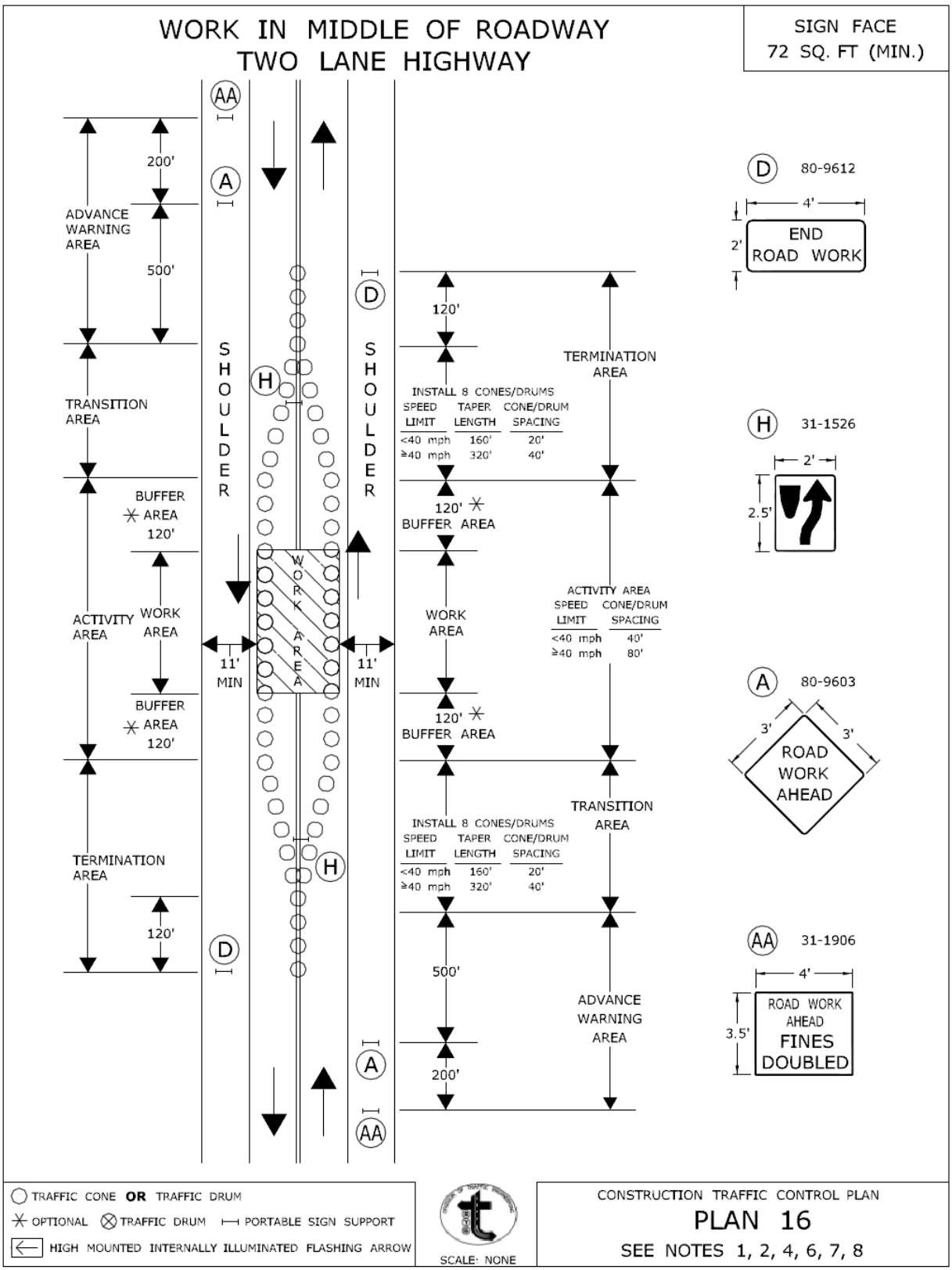
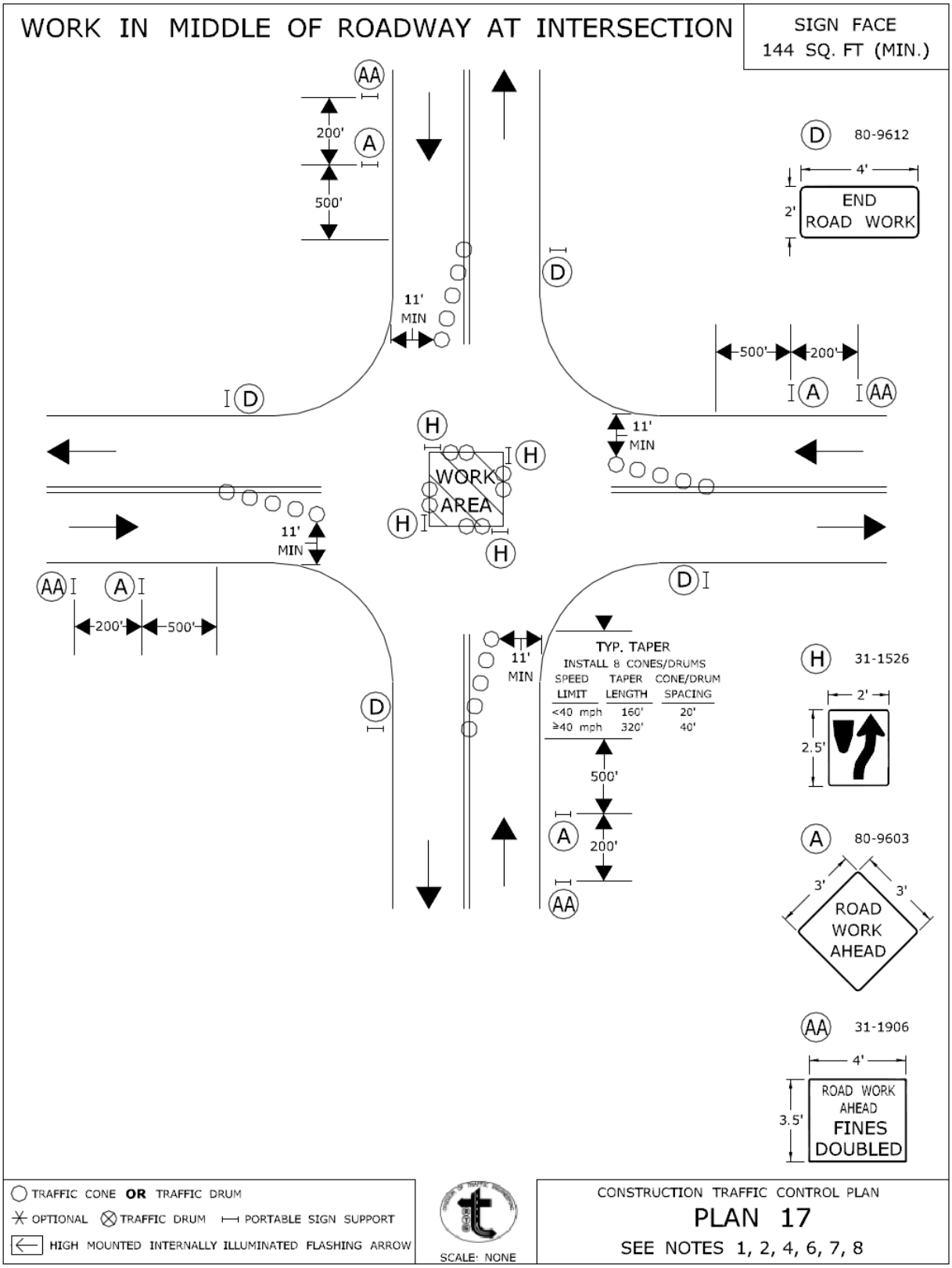
PRINCIPAL ENGINEER

PROJECT NUMBER 0431-0006 Item #0971001A


WORK IN TRAVEL LANE AND SHOULDER
TWO LANE HIGHWAY
SIGN FACE
62 SQ. FT (MIN.)
AA
A
D
200'
500'
ADVANCE WARNING AREA
TRANSITION AREA
BUFFER AREA 120'
ACTIVITY AREA
WORK AREA
BUFFER AREA 120'
TERMINATION AREA
SHOULDER
SHOULDER
WORK AREA
11' MIN
11' MIN
100'
INSTALL 8 CONES/DRUMS
SPEED LIMIT | TAPER LENGTH | CONE/DRUM SPACING
<40 mph | 160' | 20'
≥40 mph | 320' | 40'
120' BUFFER AREA
WORK AREA
120' BUFFER AREA
INSTALL 8 CONES/DRUMS
SPEED LIMIT | TAPER LENGTH | CONE/DRUM SPACING
<40 mph | 160' | 20'
≥40 mph | 320' | 40'
500'
200'
TERMINATION AREA
ACTIVITY AREA
SPEED LIMIT | CONE/DRUM SPACING
<40 mph | 40'
≥40 mph | 80'
TRANSITION AREA
ADVANCE WARNING AREA
D 80-9612
4'
2'
END ROAD WORK
A 80-9603
3'
3'
ROAD WORK AHEAD
AA 31-1906
4'
3.5'
ROAD WORK AHEAD
FINES DOUBLED
TRAFFIC CONE OR TRAFFIC DRUM
OPTIONAL
TRAFFIC DRUM
PORTABLE SIGN SUPPORT
HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW
SCALE: NONE
CONSTRUCTION TRAFFIC CONTROL PLAN
PLAN 15
SEE NOTES 1, 2, 4, 6, 7, 8
CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION
APPROVED
Charles S. Harlow
2012.06.05 15:56:29-04'00'
PRINCIPAL ENGINEER


WORK IN MIDDLE OF ROADWAY
TWO LANE HIGHWAY
SIGN FACE
72 SQ. FT (MIN.)
AA
A
D
H
200'
500'
ADVANCE WARNING AREA
TRANSITION AREA
BUFFER AREA 120'
ACTIVITY AREA
WORK AREA
BUFFER AREA 120'
TERMINATION AREA
120'
SHOULDER
SHOULDER
WORK AREA
11' MIN
11' MIN
120'
INSTALL 8 CONES/DRUMS
SPEED LIMIT | TAPER LENGTH | CONE/DRUM SPACING
<40 mph | 160' | 20'
≥40 mph | 320' | 40'
120' BUFFER AREA
WORK AREA
120' BUFFER AREA
INSTALL 8 CONES/DRUMS
SPEED LIMIT | TAPER LENGTH | CONE/DRUM SPACING
<40 mph | 160' | 20'
≥40 mph | 320' | 40'
500'
200'
TERMINATION AREA
ACTIVITY AREA
SPEED LIMIT | CONE/DRUM SPACING
<40 mph | 40'
≥40 mph | 80'
TRANSITION AREA
ADVANCE WARNING AREA
D 80-9612
4'
2'
END ROAD WORK
H 31-1526
2'
2.5'
A 80-9603
3'
3'
ROAD WORK AHEAD
AA 31-1906
4'
3.5'
ROAD WORK AHEAD
FINES DOUBLED
TRAFFIC CONE OR TRAFFIC DRUM
OPTIONAL
TRAFFIC DRUM
PORTABLE SIGN SUPPORT
HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW
SCALE: NONE
CONSTRUCTION TRAFFIC CONTROL PLAN
PLAN 16
SEE NOTES 1, 2, 4, 6, 7, 8
CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION
APPROVED
Charles S. Harlow
2012.06.05 15:56:51-04'00'
PRINCIPAL ENGINEER



TRAFFIC CONE **OR** TRAFFIC DRUM

OPTIONAL TRAFFIC DRUM PORTABLE SIGN SUPPORT

HIGH MOUNTED INTERNALLY ILLUMINATED FLASHING ARROW

SCALE: NONE

CONSTRUCTION TRAFFIC CONTROL PLAN

PLAN 17

SEE NOTES 1, 2, 4, 6, 7, 8

CONNECTICUT DEPARTMENT OF TRANSPORTATION
BUREAU OF ENGINEERING & CONSTRUCTION

APPROVED Charles S. Harlow 2012.06.05 15:57:16-04'00'
PRINCIPAL ENGINEER

Article 9.71.05 – Basis of Payment is supplemented by the following:

The temporary relocation of signs and supports, and the furnishing, installation and removal of any temporary supports shall be paid for under the item "Maintenance and Protection of Traffic". Temporary overhead sign supports and foundations shall be paid for under the appropriate item(s).

The cost of furnishing, installing, and removing the material for the 4H:1V traversable slope shall be paid for under the item "Maintenance and Protection of Traffic."

ITEM #1206023A - REMOVAL AND RELOCATION OF EXISTING SIGNS

Section 12.06 is supplemented as follows:

Article 12.06.01 – Description is supplemented with the following:
Work under this item shall consist of the removal and/or relocation of designated side-mounted extruded aluminum and sheet aluminum signs, sign posts, sign supports, and foundations where indicated on the plans or as directed by the Engineer. Work under this item shall also include furnishing and installing new sign posts and associated hardware for signs designated for relocation.

Article 12.06.03 – Construction Methods is supplemented with the following:
The Contractor shall take care during the removal and relocation of existing signs, sign posts, and sign supports that are to be relocated so that they are not damaged. Any material that is damaged shall be replaced by the Contractor at no cost to the State.

Foundations and other materials designated for removal shall be removed and disposed of by the Contractor as directed by the Engineer and in accordance with existing standards for Removal of Existing Signing.

Sheet aluminum signs designated for relocation are to be re-installed on new sign posts.

Article 12.06.04 – Method of Measurement is supplemented with the following:
Payment under Removal and Relocation of Existing Signs shall be at the contract lump sum price which shall include all extruded aluminum and sheet aluminum signs, sign posts, and sign supports designated for relocation, all new sign posts and associated hardware for signs designated for relocation, all extruded aluminum signs, sheet aluminum signs, sign posts and sign supports designated for scrap, and foundations and other materials designated for removal and disposal, and all work and equipment required.

Article 12.06.05 – Basis of Payment is supplemented with the following:
This work will be paid for at the contract lump sum price for "Removal and Relocation of Existing Signs" which price shall include relocating designated extruded aluminum and sheet aluminum signs, sign posts, and sign supports, providing new posts and associated hardware for relocated signs, removing and disposing of foundations and other materials, and all equipment, material, tools and labor incidental thereto. This price shall also include removing, loading, transporting, and unloading of extruded aluminum signs, sheet aluminum signs, sign posts, and sign supports designated for scrap and all equipment, material, tools and labor incidental thereto.

Pay Item	Pay Unit
Removal and Relocation of Existing Signs	L.S.

ITEM #1220013A – CONSTRUCTION SIGNS - BRIGHT FLUORESCENT SHEETING

Article 12.20.01 – Description: The Contractor shall furnish construction signs with bright fluorescent sheeting and their required portable supports or metal sign posts that conform to the requirements of NCHRP Report 350 (TL-3). The construction signs and their required portable supports or metal sign posts shall conform to the signing requirements stated in Article 9.71 "Maintenance and Protection of Traffic", as shown on the plans and/or as directed by the Engineer.

Article 12.20.02 – Materials: Prior to using the construction signs and their portable supports, the Contractor shall submit to the Engineer a copy of the Letter of Acceptance issued by the FHWA to the manufacturer documenting that the devices (both sign and portable support tested together) conform to NCHRP Report 350 (TL-3).

Portable sign supports shall be designed and fabricated so as to prevent signs from being blown over or displaced by the wind from passing vehicles. Portable sign supports shall be approved by the Engineer before they are used. Mounting height of signs on portable sign supports shall be a minimum of 1 foot and a maximum of 2 feet, measured from the pavement to the bottom of the sign.

All sign faces shall be rigid and reflectorized. Sheet aluminum sign blanks shall conform to the requirements of Article M.18.13. Metal sign posts shall conform to the requirements of Article M.18.14. Application of reflective sheeting, legends, symbols, and borders shall conform to the requirements specified by the reflective sheeting manufacturer. Attachments shall be provided so that the signs can be firmly attached to the portable sign supports or metal posts without causing damage to the signs. A Materials Certificate and Certified Test Report conforming to Article 1.06.07 shall be required for the reflective sheeting.

The following types of construction signs shall not be used: mesh, non-rigid, roll-up, corrugated or waffle board types substrates, foam core and composite aluminum sign substrates.

Reflective sheeting shall conform to the following:
The fluorescent orange prismatic retroreflective sheeting shall consist of prismatic lenses formed in a transparent fluorescent orange synthetic resin, sealed, and backed with an aggressive pressure sensitive adhesive protected by a removable liner. The sheeting shall have a smooth surface.

Physical Properties:

A. Photometric - Coefficient of Retroreflection R_A

When the sheeting applied on test panels is measured in accordance with ASTM E 810, it shall have minimum coefficient of retroreflection values as shown in Table I. The rotation angle shall be as designated by the manufacturer for test purposes, the observation angles shall be 0.2 degrees and 0.5 degrees, the entrance angles (component B_1) shall be -4 degrees and +30 degrees.

TABLE I

Minimum Coefficient of Retroreflection R_A

Candelas per footcandle per square foot

Observation Angle (deg.)	Entrance Angle (deg.)	R_A Orange
0.2	- 4	200
0.2	+ 30	90
0.5	- 4	80
0.5	+ 30	50

The rotation shall be as designated by the manufacturer.

B. Daytime Color

Color shall conform to the requirements of Table II. Daytime color and maximum spectral radiance factor (peak reflectance) of sheeting mounted on test panels shall be determined instrumentally in accordance with ASTM E 991. The values shall be determined on a Hunter Lab Labscan 6000 0/45 Spectrocolorimeter with option CMR 559 (or approved equal 0/45 instrument with circumferential viewing illumination). Computations shall be done in accordance with ASTM E 308 for the 2 degree observer.

TABLE II

1. Color Specification Limits** (Daytime)

Color	1		2		3		4		Reflectance Limit Y (%)	
	X	Y	X	Y	X	Y	X	Y	MIN	MAX
Orange (new)	.583	.416	.523	.397	.560	.360	.631	.369	28	-
Orange (weathered)	.583	.416	.523	.397	.560	.360	.631	.369	20	45

Maximum Spectral Radiance Factor, new: 110%, min.
weathered: 60%, min.

** The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 standard colorimetric system measured with standard illuminant D65.

C. Nighttime Color

Nighttime color of the sheeting applied to test panels shall be determined instrumentally in accordance with ASTM E 811 and calculated in the u', v' coordinate system in accordance with ASTM E 308. Sheeting shall be measured at 0.33 degrees observation and -4 degree entrance at rotation as determined by the manufacturer for test purposes. Color shall conform to the requirements of Table III.

TABLE III

Color Specification Limits ** (Nighttime)

Color	1		2		3		4	
	u'	v'	u'	v'	u'	v'	u'	v'
Orange (new and weathered)	.400	.540	.475	.529	.448	.522	.372	.534

D. Resistance to Accelerated Weathering

The retroreflective surface of the sheeting shall be weather resistant and show no appreciable cracking, blistering, crazing, or dimensional change after one year's unprotected outdoor exposure in south Florida, south-facing and inclined 45 degrees from the vertical, or after 1500 hours exposure in a xenon arc weatherometer in accordance with ASTM G26, Type B, Method A. Following exposure, panels shall be washed in a 5% HCL solution for 45 seconds, rinsed thoroughly with clean water, blotted with a soft clean cloth and brought to equilibrium at standard conditions. After cleaning, the coefficient of retroreflection shall be not less than 100 when measured as in D.2, below, and the color is expected to conform to the requirements of Tables II and III for weathered sheeting. The sample shall:

1. Show no appreciable evidence of cracking, scaling, pitting, blistering, edge lifting or curling or more than 0.031 inch shrinkage or expansion.

2. Be measured only at angles of 0.2 degrees observation, -4 degrees entrance, and rotation as determined by the manufacturer for test purposes. Where more than one panel of color is measured, the coefficient of retroreflection shall be the average of all determinations.

E. Impact Resistance

The retroreflective sheeting applied according to the manufacturer's recommendations to a test panel of alloy 6061-T6, 0.040 inch by 3 inches by 5 inches and conditioned for 24 hours, shall show no cracking outside the impact area when the face of the panel is subjected to an impact of 100 inch-pounds, using a weight with a 0.625 inch diameter rounded tip dropped from a height necessary to generate an impact of 100 inch-pounds, at test temperatures of both 32° F and 72° F.

F. Resistance to Heat

The retroreflective sheeting, applied to a test panel as in E., above, and conditioned for 24 hours, shall be measured in accordance with Paragraph A. at 0.2 degree observation and -4 degree entrance angles at rotation as determined by the manufacturer for test purposes and exposed to 170° ± 5° F for 24 hours in an air circulating oven. After heat exposure the sheeting shall retain a minimum of 70% of the original coefficient of retroreflection.

G. Field Performance:

Retroreflective sheeting processed and applied to sign blank materials in accordance with the sheeting manufacturer's recommendations, shall perform effectively for a minimum of 3

years. The retroreflective sheeting will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that: (1) the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions; or (2) the coefficient of retroreflection is less than 100 when measured at 0.2 degrees observation and -4 degree entrance. All measurements shall be made after sign cleaning according to the sheeting manufacturer's recommendations.

Article 12.20.03 – Construction Methods: Ineffective signs, as determined by the Engineer and in accordance with the ATSSA guidelines contained in "Quality Standards for Work Zone Traffic Control Devices", shall be replaced by the Contractor at no cost to the State.

Signs and their portable sign supports or metal posts that are no longer required shall be removed from the project and shall remain the property of the Contractor.

Article 12.20.04 – Method of Measurement: Construction Signs - Bright Fluorescent Sheeting will be measured for payment by the number of square feet of sign face. Sign supports will not be measured for payment.

Article 12.20.05 – Basis of Payment: "Construction Signs - Bright Fluorescent Sheeting" required and used on the project will be paid for at the Contact unit price per square foot. This price shall include the furnishing and maintenance of the signs, portable sign supports, metal sign posts and all hardware. Each sign and support or posts will be paid for once, regardless of the number of times it is used.

Pay Item	Pay Unit
Construction Signs – Bright Fluorescent Sheeting	S.F.

ITEM #1700001A – SERVICE CONNECTIONS (ESTIMATED COST)

Description: This work shall consist of disconnection, alteration and reconnection of those existing utility services owned by property owners at locations necessary to complete this project and as ordered by the Engineer. This work shall include the coordination with the affected utility companies and customers. Any damage caused by the Contractor or Subcontractors, as determined by the Engineer, shall be corrected by the Contractor in accordance with this specification.

Materials: All materials shall be provided by the Contractor and shall meet the current standards of the affected service.

Construction Methods: The Contractor shall perform all work in coordination with the Utility Company and affected property owner and as directed by the Engineer. Certain work may require use of a licensed and/or certified tradesman when such work is required by local and/or state codes.

Any utility customer's service interruption shall be done in a way that minimizes adverse impacts to the customer and affected utility.

Any work and materials supplied by the utility companies shall be on a billable basis to the Contractor.

Method of Measurement: The work and materials shall be measured for payment as provided for under Article 1.04.05 Extra Work.

The sum of money shown on the estimate and in the itemized proposal as "Estimated Cost" for this work will be considered the price bid even though payment will be made only for actual work performed. The estimated cost figure is not to be altered in any manner by the bidder. Should the bidder alter the amount shown, the altered figure will be disregarded and the original price will be used to determine the total amount for the contract.

Corrective work required to repair damage caused by the Contractor or its Subcontractors shall not be measured for payment.

Basis of Payment: This work will be paid as Extra Work.

Pay Item	Pay Unit
Service Connections (Estimated Cost)	Estimated Cost

PERMITS AND/OR SUPPLEMENTAL TO FORM 816 AND REQUIRED PROVISIONS:

The following Permits and/or Supplemental to Form 816 and Required Provisions follow this page and are hereby made part of this Contract.

- **PERMIT(S) AND/OR PERMIT APPLICATION(S)**
  GENERAL PERMIT REGISTRATION FORM FOR THE DISCHARGE OF STORMWATER AND DEWATERING

- **SUPPLEMENTAL SPECIFICATIONS TO STANDARD SPECIFICATIONS FORM 816**

- **Construction Contracts - Required Contract Provisions (FTA Funded Contracts)**

WATERBURY BUS MAINTENANCE FACILITY
WATERTOWN, CONNECTICUT
STATE PROJECT NUMBER 0431-0006

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0100150A, 0100151A	26 24 16 (OPS)	PANELBOARDS (OFF-SITE PUMP STATION NO.2)
0100150A	26 27 13	ELECTRICITY METERING
0100150A, 0100151A	26 27 13 (OPS)	ELECTRICITY METERING (OFF-SITE PUMP STATION NO.2)
0100150A	26 27 26	WIRING DEVICES
0100150A	26 28 13	FUSES
0100150A	26 28 16	SAFETY SWITCHES
0100150A	26 29 00	MOTOR CONTROLLERS
0100150A	26 32 13	ENGINE GENERATOR SYSTEMS
0100150A, 0100151A	26 32 13 (OPS)	ENGINE GENERATORS (OFF-SITE PUMP STATION NO.2)
0100150A	26 32 13A	GENERATOR CAPTEST
0100150A	26 36 00	TRANSFER SWITCHES
0100150A, 0100151A	26 36 00(OPS)	SERVICE ENTRANCE TRANSFER SWITCHES (OFF-SITE PUMP STATION NO.2)
0100150A	26 41 13	LIGHTNING PROTECTION SYSTEM
0100150A	26 51 00	INTERIOR LIGHTING FIXTURES
0100150A	26 51 10	LAMPS AND BALLASTS
0100150A	26 56 00	EXTERIOR LIGHTING
0100150A, 0100151A	26 56 00 (OPS)	EXTERIOR LIGHTING (OFF-SITE PUMP STATION NO.2)

DIVISION 27 – COMMUNICATIONS

0100150A	27 05 33	TELECOMMUNICATIONS RACEWAY SYSTEM
0100150A	27 15 00	COMMUNICATIONS HORIZONTAL CABLING
0100150A	27 30 00	TELEPHONE SYSTEMS

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

0100150A	28 13 00	ACCESS CONTROL
0100150A	28 23 04	INDOOR AND OUTDOOR SURVEILLANCE CCTV SYSTEM
0100150A	28 31 00	ADDRESSABLE FIRE ALARM DETECTION SYSTEM
0100150A	28 33 00	WIRELESS CLOCK SYSTEMS

DIVISION 30 - FORM 816 UNITS PRICE SITE WORK

0100150A, 0100151A	30 00 00	FORM 816 SITE WORK
	2.01	CLEARING AND GRUBBING
	2.02	ROADWAY EXCVATION, FORMATION OF EMBANKMENT AND DISPOSAL OF SURPLUS MATERIAL
	2.03	STRUCTURE EXCAVATION
	2.04	COFFERDAM AND DEWATERING
	2.05	TRENCH EXCAVATION
	2.07	BORROW
	2.08	FREE-DRAINING MATERIAL
	2.09	SUBGRADE
	2.10	WATER POLLUTION CONTROL (SOIL EROSION)
	2.12	SUBBASE
	2.13	GRANULAR FILL
	2.14	COMPACTED GRANULAR FILL
	2.16	PERVIOUS STRUCTURE BACKFILL
	2.18	SEDIMENTATION CONTROL BALES
	2.19	SEDIMENTATION CONTROL SYSTEM
	3.04	PROCESSED AGGREGATE BASE
	4.01	CONCRETE PAVEMENT
	5.06	RETAINING WALLS, ENDWALLS AND STEPS
	5.07	CATCH BASINS, MANHOLES AND DROP INLETS
	6.01	CONCRETE FOR STRUCTURES
	6.02	REINFORCING STEEL
	6.12	CONCRETE CYLINDER CURING BOX

6.51	CULVERTS
6.52	CULVERT ENDS
7.03	RIPRAP
7.51	UNDERDRAIN AND OUTLETS
7.55	GEOTEXTILE
8.11	CONCRETE CURBING
9.13	CHAIN LINK FENCE
9.21	CONCRETE SIDEWALKS
9.39	SWEEPING FOR DUST CONTROL
9.43	WATER FOR DUST CONTROL
9.44	TOPSOIL
9.49	FURNISHING, PLANTING and MULCHING TREES, SHRUBS, VINES and GROUND COVER PLANTS
9.50	TURF ESTABLISHMENT
12.09	PAINTED PAVEMENT MARKINGS

DIVISION 31- EARTHWORK

0100150A, 0100151A	31 23 19	DEWATERING
0100150A, 0100151A	31 25 00	TEMPORARY EROSION AND SEDIMENTATION CONTROLS
0100150A	31 30 00	LOW DENSITY FOAM CONCRETE FILL (LDFC)

DIVISION 32 - EXTERIOR IMPROVEMENTS

0100150A	32 14 00	UNT PAVING

DIVISION 33 UTILITIES

0100150A, 0100151A	33 10 00	WATER DISTRIBUTION SYSTEM
0100150A, 0100151A	33 30 00	SANITARY SEWER
0100150A, 0100151A	33 32 13.13A.4	ABOVE GROUND WET WELL MOUNTED QUAD-PLEX PUMP STATION, PUMP STATION 2
0100150A	33 32 13.13B.2	RECESSED WET WELL MOUNTED DUPLEX PUMP STATION, PUMP STATION NO. 1
0100150A	33 41 00	STORM UTILITY DRAINAGE PIPING & STRUCTURES

SECTION 013233 – PROGRESS PHOTOGRAPHS

PART 1 - GENERAL

1.1 SUMMARY:

A. The Contractor shall engage a qualified commercial photographer to take photographs during construction. The photographer shall be a firm or an individual of established reputation that has been regularly engaged as a professional photographer for not less than 3 years.

B. At the Preconstruction Meeting, submit to the Designer for approval the name of the photographer whom will be responsible for taking the photographs during construction.

1.2 SUBMITTALS:

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Submit photos of each view within seven (7) calendar days of taking photographs. Three (3) photographic sets of photos shall be submitted. ALL photos shall be submitted in IBM-PC compatible digital format on compact disc (CD). Other than the photo thumbnail index and the photo key plan required for submission with each CD, no other hardcopy photos shall be required for the project. One (1) set of photos (on CD) of each submittal shall be sent directly to:

- District 1A Construction, Connecticut Department of Transportation, 700 State Street, New Haven, Connecticut 06511, Attention Lynn Cichowski.

C. Each CD and CD jewel case shall be labeled with the name of the project, State project number, name of the Contractor, date of submission, and name and address of the photographer.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Provide digital images in IBM-PC compatible JPEG format, with uncompressed (open) image size equal to or greater than the following dimensions: Pixel Dimensions = 1596 x 2000; Resolution = 200 pixels/inch. JPEG compression for each image shall equal “Quality 7” (High). Images shall be color (RGB mode).

B. Digital Cameras used for the purpose of creating the above noted image files shall have a minimum sensor size of 7 million pixels.

C. Image files shall be named and a photo thumbnail index created with the following file naming convention: *Project number_date of submission_photo number.jpg*

For example: If the first set of photos on CD for project number 159-0181, is submitted on 12/13/01, the first photo of the submission shall be file named: 1590181_121301_1.jpg and the tenth photo of the set shall be file named: 1590181_121301_10.jpg. In the second set of photos on CD, submitted 1/12/02, the first photo of the set shall be file named: 1590181_011202_1.jpg

D. A hardcopy "Photo Thumbnail" index shall be provided with each CD submission. The photo thumbnails shall be printed on 8 ½" x 11" "glossy photo quality" ink jet paper with a minimum 720 dot-per-inch ink jet printer. The thumbnail images shall be a minimum 200 x 250 pixels at 200 pixel per inch resolution. The file names shall be located under each image. The thumbnail images shall be arranged so that they can all be contained on a single 8 ½-in by 11-in inkjet print. *For example*, 35 images would be arranged in five (5) columns and seven (7) rows. The CD shall also contain the digital file of the photo thumbnail index in jpeg format. The file shall share the same format as the above noted photo file format but the word "index" shall be placed in the location of the photo number. *For example*: 1590181_121301_index1.jpg

E. Photos shall be numbered and referenced by number on a "Photo Key Plan." A hardcopy of the photo key plan shall be provided with each CD submission. The photo key plan shall be printed on 8 1/2"x 11" "glossy photo quality" ink jet paper with a minimum 720 dot-per-inch ink jet printer. The key plan shall be made on digital images of the projects overall site plans and/or the overall building plans, as appropriate for the photos being submitted, and shall include an arrow pointing in the direction of the photo with the associated photo number. The CD shall also contain the digital file of the photo key plan in jpeg format. The file shall share the same format as the above noted photo file format but the word "key plan" shall be placed in the location of the photo number: 1590181_121301_keyplan1.jpg.

F. In lieu of using a digital camera to provide the above noted image files, standard 35 mm cameras and 35 mm color negative film may be used to take the images, and the images may then be captured as a digital file through the use of a designated 35mm film scanner. The 35mm scanner must have the following minimum specifications: 2700 dot per inch optical resolution; 3.4 Dmax; 36 bit color depth. The use of flatbed scanners shall not be permitted for this purpose.

G. Project progress photos shall be submitted as digital files on write-once CD-ROM in a jewel case on a monthly basis. All subsequent CD submissions shall include the image files of the previous submissions and an updated hardcopy of the photo thumbnail index that contains all current and previous photos.

PART 3 - EXECUTION

3.1 EXECUTION:

A. Where used herein, one set of photographs will be defined as 24 photographs.

B. Before starting construction, take one set of color photographs of the site and surrounding properties from different points of view as selected by the Engineer. Take photographs to show existing conditions to the property before starting Work. Take photographs of existing buildings either on or adjoining the property in sufficient detail to record accurately the physical conditions at the start of construction.

C. Take one set of color photographs at no greater than monthly intervals, coinciding as closely as possible with the completion of a major construction phase. The photographer shall select the vantage points for each shot each month to best show the status of construction and progress since the last photographs were taken. Prior to taking any photographs, review the proposed vantage points for each shot with the Engineer. Photographs are for a record of the progress of work. Therefore, they shall be taken at a maximum interval of one month, whether or not they show any completion of work performed during the preceding month.

D. Take one set of color photographs upon notification by the Engineer of Final Inspection of the Project. Prior to taking any photographs, review the proposed vantage points for each shot with the Engineer. Take photographs from opposing views of the site in an effort to display various characteristics of the new construction.

END OF SECTION 013233

SECTION 017000 – CONSTRUCTION STAKING

PART 1 - GENERAL

1.1 SUMMARY:

A. The Contractor shall perform, including related administrative and procedural requirements, the following: construction layout and staking, field engineering and surveying, utility locations, general support services related to proposed construction methodology involving structural integrity or personnel safety, and civil engineering services.

B. Engage a Land Surveyor licensed in the State of Connecticut who is experienced in providing land-surveying services of the kind indicated.

C. Engage a Professional Engineer of the discipline required, licensed in the State of Connecticut, to perform engineering services of the kind indicated.

1.2 SUBMITTALS:

A. Submit a certificate signed by the Contractor and co-signed by a Land Surveyor or Professional Engineer certifying that the location and elevation of improvements comply with the Contract.

B. Submit a record of Project work performed and project data as required under provisions of Form 816 Article 1.20-1.08.14.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Project Record Drawings: Appropriate scale reproducible final drawings shall be submitted to the Engineer. Drawings shall conform to an “Existing Building Location Survey” with a Class T-2 accuracy standard in accordance with the Connecticut General Statues, Section 20-300b.

PART 3 - EXECUTION

3.1 EXECUTION:

A. The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities and other construction affecting the work. Furnish location data for Project work that must be performed by public utilities serving the Project Site.

B. Furnish information that is necessary to adjust, move or relocate existing structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

C. The existing benchmarks, control points and property corners are shown on the plans.

D. Verify layout information shown on the plans, in relation to the control points and existing benchmarks before proceeding to layout the Project work. Notify the Engineer if discrepancies are discovered. Locate existing permanent benchmarks, control points, and similar reference points before beginning Project work. Preserve and protect permanent benchmarks and control points during construction operations. Do not change or relocate benchmarks or control points without the Engineer’s prior written approval. Promptly report lost or destroyed control points, or the need to relocate permanent benchmarks or control points because of necessary changes in grades or locations. Promptly replace lost or destroyed benchmarks and control points. Base replacements on the original survey control points.

E. Establish and maintain a minimum of (2) permanent benchmarks on the Project Site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark. Record benchmark locations, with horizontal and vertical data, on Project Record Documents. Provide temporary reference points sufficient to locate the work where the actual location or elevation of layout points cannot be marked. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

F. Construction methodology shall be the Contractor's sole responsibility including the cost of using engineering services and recommendations as necessary. Inform the Engineer of any anticipated or encountered problems in construction methodology. Proceed with work only when such problems are fully resolved by the Contractor, using such engineering support services as required.

G. Work from lines and levels established by the control survey. Establish benchmarks and control points to set lines and levels at each area of construction as needed to locate each element of the Project. Calculate and measure required dimensions within indicated or recognized tolerances. Do not scale plans to determine dimensions. Advise entities engaged in construction activities, of marked lines and levels provided for their use. As construction proceeds, check every major element for line, level and plumb.

H. Locate and lay out site improvements, including pavements, stakes for grading, fill and topsoil placement, utility slopes and invert elevations by instrumentation and similar appropriate means. The Contractor shall identify and document by survey the extent, elevation, and location of all foundations and capped utilities to be left in place and backfilled. Appropriate scaled marked up drawings shall be furnished to the Engineer PRIOR to backfilling.

I. Locate and lay out control lines and levels for structures, building foundations, column grids and locations, floor levels including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from (2) or more locations.

J. Maintain a surveyor's log of control and other survey work. Make this log available to the Engineer for reference. Record deviations from required lines and levels, and advise the Engineer when deviations that exceed indicated or recognized tolerances are detected. On Project Record Drawings, record deviations that are accepted by the Engineer and not corrected. Record the location of utilities at the time of installation in the log as well as on mylar for permanent record. The recording Land Surveyor shall place its registration seal and accuracy statement regarding location of exterior underground utility lines on the utility plans of As-Built tracings.

END OF SECTION 017000

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

B. Related Requirements:
1. Section 042000 "Unit Masonry" for disposal requirements for masonry waste.
2. Section 018113 “ High Performance Buildings Design Requirements”

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials.

1. Demolition Waste including, but not limited to:

a. Asphalt paving.
b. Concrete.
c. Concrete reinforcing steel.
d. Brick.
e. Concrete masonry units.
f. Wood studs.
g. Wood joists.
h. Plywood and oriented strand board.
i. Wood paneling.
j. Wood trim.
k. Structural and miscellaneous steel.
l. Rough hardware.
m. Roofing.
n. Insulation.
o. Doors and frames.
p. Door hardware.
q. Windows.
r. Glazing.
s. Metal studs.
t. Gypsum board.
u. Acoustical tile and panels.
v. Carpet.
w. Carpet pad.
x. Demountable partitions.
y. Equipment.
z. Cabinets.
aa. Plumbing fixtures.
bb. Piping.
cc. Supports and hangers.
dd. Valves.
ee. Sprinklers.
ff. Mechanical equipment.
gg. Refrigerants.
hh. Electrical conduit.
ii. Copper wiring.
jj. Lighting fixtures.
kk. Lamps.
ll. Ballasts.
mm. Electrical devices.
nn. Switchgear and panelboards.
oo. Transformers.

2. Construction Waste, including but not limited to:

   a. Masonry and CMU.
   b. Lumber.
   c. Wood sheet materials.
   d. Wood trim.
   e. Metals.
   f. Roofing.
   g. Insulation.
   h. Carpet and pad.
   i. Gypsum board.
   j. Piping.
   k. Electrical conduit.
   l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:

      1) Paper.
      2) Cardboard.
      3) Boxes.
      4) Plastic sheet and film.
      5) Polystyrene packaging.
      6) Wood crates.
      7) Plastic pails.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Waste Management Plan: General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan. Distinguish between demolition and construction waste. Indicate quantities by weight and use the same units of measure throughout waste management plan.

C. Submit plan within 7 days of date established for **the Notice to Proceed**. Plan must include the following:

   1. Education Plan ad signage for subcontractors.
   2. Location of containers.
   3. If separation is occurring off-site at a comingled or mixed-debris processing plant, provide documentation for the amount of waste processed, by weight as well as a diversion rate from the facility. This could be either a project-specific diversion rate supplied by the facility, or a letter from the state regulating body with the facility's average rate of recycling.
   4. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

5. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
6. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
7. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
8. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste or approved forms by HPB Administrator.

1. Provide a biweekly log and progress report, including all weigh tickets, receipts and project specific diversion rate from recycling companies. For final submission, include a letter template for credit 16a-38k-4(d)(4) and 16a-38k-4(d)(5), signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

D. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

E. Qualification Data: For waste management coordinator.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements to serve as a waste management coordinator.

B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.

2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

E. Waste Management in Historic Zones or Areas: Hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by 12 inches (300 mm) or more.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work: For any items salvaged onsite, reuse and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Owner's Use: For any item salvaged for Owner's use, handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper, beverage containers, glass, metal, and plastic containers deemed acceptable for recycling by local recycling agency, used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be decided upon by the owner at preconstruction meeting.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: Grind asphalt to maximum 1-1/2-inch (38-mm) size.

1. Crush asphaltic concrete paving and screen to comply with requirements in Section 312000 "Earth Moving" for use as general fill.

B. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.

C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum 1-1/2-inch (38-mm) size.
2. Crush concrete and screen to comply with requirements in Section 312000 "Earth Moving" for use as satisfactory soil for fill or subbase.

D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Pulverize masonry to maximum 1-1/2-inch (38-mm) size.

    a. Crush masonry and screen to comply with requirements in Section 312000 "Earth Moving" for use as general fill.

2. Clean and stack undamaged, whole masonry units on wood pallets.

E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

F. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

G. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.

H. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

I. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

J. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.

K. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.

1. Store clean, dry carpet and pad in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

L. Carpet Tile: Remove debris, trash, and adhesive.

1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

M. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

N. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

a. Comply with requirements in Section 329300 "Plants" for use of clean ground gypsum board as inorganic soil amendment.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

3.7 ATTACHMENTS

A. Sample Form CWM-3 for construction waste reduction work plan.

B. Sample Form CWM-4 for demolition waste reduction work plan.

C. Sample Form CWM-7 for construction waste

D. Sample Form CWM-8 for demolition waste.

END OF SECTION 017419

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FORM CWM-3: CONSTRUCTION WASTE REDUCTION WORK PLAN

MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS (TONNES)	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS (TONNES)	EST. AMOUNT RECYCLED TONS (TONNES)	EST. AMOUNT DISPOSED TO LANDFILL TONS (TONNES)	
Packaging: Cardboard						
Packaging: Boxes						
Packaging: Plastic Sheet or Film						
Packaging: Polystyrene						
Packaging: Pallets or Skids						
Packaging: Crates						
Packaging: Paint Cans						
Packaging: Plastic Pails						
Site-Clearing Waste						
Masonry or CMU						
Lumber: Cut-Offs						
Lumber: Warped Pieces						
Plywood or OSB (scraps)						
Wood Forms						
Wood Waste Chutes						
Wood Trim (cut-offs)						
Metals						
Insulation						
Roofing						
Joint Sealant Tubes						
Gypsum Board (scraps)						
Carpet and Pad (scraps)						
Piping						
Electrical Conduit						
Other:						

SAMPLE

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FORM CWM-4: DEMOLITION WASTE REDUCTION WORK PLAN

MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS (TONNES)	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS (TONNES)	EST. AMOUNT RECYCLED TONS (TONNES)	EST. AMOUNT DISPOSED TO LANDFILL TONS (TONNES)	
Asphaltic Concrete Paving						
Concrete						
Brick						
CMU						
Lumber						
Plywood and OSB						
Wood Paneling						
Wood Trim						
Miscellaneous Metals						
Structural Steel						
Rough Hardware						
Insulation						
Roofing						
Doors and Frames						
Door Hardware						
Windows						
Glazing						
Acoustical Tile						
Carpet						
Carpet Pad						
Demountable Partitions						
Equipment						
Cabinets						
Plumbing Fixtures						
Piping						
Supports and Hangers						
Valves						
Sprinklers						
Mechanical Equipment						
Electrical Conduit						
Copper Wiring						
Light Fixtures						
Lamps						
Lighting Ballasts						
Electrical Devices						
Switchgear and Panelboards						
Transformers						
Other:						

SAMPLE

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FORM CWM-7: CONSTRUCTION WASTE REDUCTION PROGRESS REPORT

MATERIAL CATEGORY	GENERATION POINT	TOTAL QUANTITY OF WASTE TONS (TONNES) (A)	QUANTITY OF WASTE SALVAGED		QUANTITY OF WASTE RECYCLED		TOTAL QUANTITY OF WASTE RECOVERED TONS (TONNES) (D = B + C)	TOTAL QUANTITY OF WASTE RECOVERED % (D / A x 100)
			ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (B)	ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (C)		
Packaging: Cardboard								
Packaging: Boxes								
Packaging: Plastic Sheet or Film								
Packaging: Polystyrene								
Packaging: Pallets or Skids								
Packaging: Crates								
Packaging: Paint Cans								
Packaging: Plastic Pails								
Site-Clearing Waste								
Masonry or CMU								
Lumber: Cut-Offs								
Lumber: Warped Pieces								
Plywood or OSB (scraps)								
Wood Forms								
Wood Waste Chutes								
Wood Trim (cut-offs)								
Metals								
Insulation								
Roofing								
Joint Sealant Tubes								
Gypsum Board (scraps)								
Carpet and Pad (scraps)								
Piping								
Electrical Conduit								
Other:								

SAMPLE

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FORM CWM-8: DEMOLITION WASTE REDUCTION PROGRESS REPORT

MATERIAL CATEGORY	GENERATION POINT	TOTAL QUANTITY OF WASTE TONS (TONNES) (A)	QUANTITY OF WASTE SALVAGED		QUANTITY OF WASTE RECYCLED		TOTAL QUANTITY OF WASTE RECOVERED TONS (TONNES) (D = B + C)	TOTAL QUANTITY OF WASTE RECOVERED % (D / A x 100)
			ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (B)	ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (C)		
Asphaltic Concrete Paving								
Concrete								
Brick								
CMU								
Lumber								
Plywood and OSB								
Wood Paneling								
Wood Trim								
Miscellaneous Metals								
Structural Steel								
Rough Hardware								
Insulation								
Roofing								
Doors and Frames								
Door Hardware								
Windows								
Glazing								
Acoustical Tile								
Carpet								
Carpet Pad								
Demountable Partitions								
Equipment								
Cabinets								
Plumbing Fixtures								
Piping								
Supports and Hangers								
Valves								
Sprinklers								
Mechanical Equipment								
Electrical Conduit								
Copper Wiring								
Light Fixtures								
Lamps								
Lighting Ballasts								
Electrical Devices								
Switchgear and Panelboards								
Transformers								

SAMPLE

Other:								

SAMPLE

SECTION 018113.13 - 1 - HIGH PERFORMANCE BUILDINGS SUSTAINABLE REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general and specific requirements and procedures for compliance with the State of Connecticut High Performance Buildings Guidelines (HPB), inclusive of both mandatory (prerequisites) and targeted optional strategies (credits).

1. Other prerequisites and credits needed for HPB compliancy may depend on product selections and may not be specifically identified as HPB requirements. Compliance with requirements needed to obtain HPB prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
2. A copy of the HPB checklist is attached at the end of this Section for information only. The HPB Administrator &/or project architect may adjust, revise, and/or update the checklist on behalf of the owner during the course of the project, and may periodically issue revised checklists to the Contractor.

B. Contractor shall be responsible to assemble all documentation necessary to demonstrate compliancy with construction related prerequisites and credits to Department of Construction Services (DCS). Specifically, Contractor is responsible to submit all documentation to the Project HPB Administrator for initial review and provide any and all necessary documentation to demonstrate compliance with the requirements of the identified credits including any additional verification deemed necessary by DCS.

C. Contractors shall review all proposed products, verify compliance with the referenced credit standards, and provide manufacturer documentation as required by HPB Administrator for project certification. If product documentation is not immediately available, the measures necessary to demonstrate compliance shall not impact project cost or schedule. Contractor shall be required to provide all documentation required for DCS construction review within 30 days of substantial completion. Contractor may be required provide additional information as needed until DCS has deemed the project in full compliance with HPB. Contractor will cooperate with the Owner to complete this process without additional cost to the Owner regardless of the length of time required to complete the process.

D. Related Sections:

1. Division 01 Section “Commissioning”.
2. Division 01 Section “Construction Waste Management”.

1.3 DEFINITIONS

A. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.

B. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

C. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.

1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.
3. Volatile Organic Compounds (VOCs): Any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions. Compounds that have negligible photochemical reactivity, listed in EPA 40 CFR 51.100(s). are also excluded from this regulatory definition

1.4 ADMINISTRATIVE REQUIREMENTS

A. Respond to questions and requests from Owner’s Project HPB Administrator and the DCS regarding HPB credits that are the responsibility of the Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures until the DCS has made its determination on the project's HPB certification application. Document responses as informational submittals.

B. HPB Coordinator will respond to questions and requests from Architect and the DCS regarding HPB credits that are the responsibility of the Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures until DCS has made its determination on the project's HPB certification application. Document responses as informational submittals.

C. Documentation format

D. Contractor HPB Coordinator shall be responsible for successful documentation of all credits stated to be Contractor responsibility. Additional submittals may be required throughout construction as deemed necessary by project HPB Administrator to verify and/or confirm compliance with targeted credits.

E. Contractor HPB Coordinator shall be present for all relevant HPB meetings.

F. Status of HPB green building-related work shall be on the agenda of all required regularly scheduled job-site meetings.

1.5 ACTION SUBMITTALS

A. HPB submittals are in addition to other submittals. An HPB submittal may be identical to documentation submitted to comply with other technical requirements. HPB submittals shall be a separate file submitted with the standard product submittal as required by the technical specifications. Contractor shall verify compliancy with the basis of design and HPB credit prior to submitting to HPB Administrator.

B. Each HPB submittal shall be identified by this Division number and the appropriate corresponding technical specification number. For example, Section 321216, “Asphalt Paving” would be identified as, 018113.13-321216.

C. HPB Documentation Submittals:

1. Mandatory Provision 16a-38k-3(h): Erosion and Sedimentation Control: Provide a summary, sample log, checklist, inspection report, or similar document that demonstrates periodic inspection of the implemented measures. This documentation must include:

   a. Sample dates
   b. Monthly Inspection frequency, year-round.
   c. At least 3 inspections equally spaced over the site work period
   d. Descriptions of any corrective action taken.
   e. Photo documentation, digitally dated at each inspection, of measures taken to meet erosion and sedimentation control requirements.

2. Mandatory Provision 16a-38k-3(a): Building Commissioning: Documentation confirming the following:

   a. Review of Owner Project Requirements, Basis of Design, Design Documents review, Back check of Design review, and contractor submittals.
   b. Commissioning Report
   c. Energy and Systems manual
   d. Post-Occupancy Report and survey: Occupant review 10 months after substantial completion, including development of a resolution plan.

3. Mandatory Provision 16a-38k-3(c): Base Energy Performance: Documentation indicating that submitted products comply with the basis of design, applicable requirements in ASHRAE/IESNA 90.1 2007 and meet HPB performance goals.
4. Mandatory Provision 16a-38k-3(k) CFC Refrigerant Ban and credit 16a-38k-4(f)(1) Eliminate use of CFCs, HCFCs, and Halons: and : Documentation indicating units and fire suppression systems are designed to meet HPB requirements.
5. Credit 16a-38k-4(d) (4) and 16a-38k-4(d) (5) Recycle and Salvage Construction and Demolition Waste: Comply with Section 017419 "Construction Waste Management and Disposal."
6. Credit 16a-38k-4(d)(8) and 16a-38k-4(d)(9) Recycled Content: Submittals for all materials with recycled content (excluding MEP systems equipment and components) must include the following documentation:

a. Statement indicating material cost for each product having recycled content.
b. Manufacturer's product data or a letter from the manufacturer verifying the percentage of post-consumer and pre-consumer recycled content, by weight, of each material or product
c. A spreadsheet that tabulates the Project's total materials cost and combined recycled content value (defined as the sum of the post-consumer recycled content value plus one-half of the pre-consumer recycled content value) expressed as a percentage of total materials cost. This spreadsheet shall be submitted with each Contractor's Application for Payment. It should indicate, on an ongoing basis, line items for each material, including cost, pre-consumer recycled content, post-consumer recycled content, and combined recycled content value.

7. Credit 16a-38k-4(d)(10) and 16a-38k-4(d)(11) Regional Material: Submittals for all products or materials expected to contribute to the regional calculation (excluding MEP systems equipment and components) must include the following documentation:

   a. Statement indicating cost for each regional material and the fraction by weight that is considered regional.
   b. Location of point of extraction, harvest, or recovery for each raw material in each product and distance from the point of extraction, harvest, or recovery to the Project Site.
   c. Manufacturer's product data or a letter from the manufacturer verifying the location and distance from the Project Site to the point of extraction, harvest, or recovery for each regional material or product.
   d. A spreadsheet that tabulates the Project's total materials cost and regional materials value, expressed as a percentage of total materials cost. This spreadsheet shall be submitted with each Contractor's Application for Payment. It should indicate on an ongoing basis, line items for each material, including cost, location of manufacture, distance from manufacturing plant to the Project Site, location of raw material extraction, and distance from extraction point to the Project Site.

8. Credit 16a-38k-4(d) (13): Contractor shall collect all vendor invoices for permanently installed wood products, FSC or not. Vendor invoice must conform to the following requirements:

   a. Each wood product must be identified on a line-item basis.
   b. FSC products must be identified on a line-item basis and identified as FSC "Pure," FSC Mixed Credit, or FSC Mixed [NN] %. If product is FSC Mixed [NN] %, product should be valued at indicated percentage of product cost.
   c. The dollar value of each line item must be shown.
   d. Te vendors COC certificate number must be shown on any invoice that includes FSC products.
   e. Contractor will supply a letter from the vendor stating that the products provided are FSC- certified (FSC Pure, FSC Mixed Credit, FSC Mixed [NN] %.

9. Mandatory Provision 16a-38k-3(l): Documentation indicating that submitted products comply with the basis of design and ASHRAE 62.1, Section 5 - "Systems and Equipment."
10. Credit 16a-38k-4(b)(1):
    a. Documentation indicating that units are equipped with a direct outdoor airflow-measuring device capable of measuring the minimum outdoor airflow to meet design minimum airflow rate, as defined by ASHRAE 62.1.

b. Documentation indicating installation of permanent indoor air monitoring systems that measure, at a minimum, temperature, relative humidity, carbon dioxide, dew point. Carbon dioxide measurement sensors shall measure both interior and exterior levels.

11. Credit 16a-38k-3(e): Construction Indoor Air Quality Management Plan-During Construction. Contractor's plan shall demonstrate compliance with the SMACNA IAQ Guidelines for Occupied Buildings under Construction, 2nd edition, 2007, ANSI/SMACNA 008-2008, and Chapter 3. The following shall be included:

    a. A list of filtration media utilized, including manufacturer, model number, MERV rating, date of installation, and date of replacement.
    b. Product data for filtration media used during occupancy.
    c. Provide documentation confirming that smoking was not allowed inside the building or within 25 feet of any opening during construction.
    d. Construction Documentation: A minimum of six electronically dated photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials. Measures to protect materials from moisture damage must be included in photo documentation.

12. Credit 16a-38k-4(b)(4): Low-Emitting Materials

    a. Interior Adhesives and Sealants: Maintain a list of each indoor adhesive and sealant used. Include the manufacturer's name, product name, and specific VOC data (g/L, less water) for each product. Submit Product Data demonstrating that all adhesives and sealants installed in the building interior do not exceed the allowable VOC limit. This spreadsheet shall be submitted with each Contractor's Application for Payment

13. Credit 16a-38k-4(b) (5) Interior Paints and Coatings: Maintain a list of each indoor paint or coating products used. Include the manufacturer's name, product name, and specific VOC data (g/L, less water) for each product. Submit Product Data demonstrating that all adhesives and sealants installed in the building interior do not exceed the allowable VOC limit. This spreadsheet shall be submitted with each Contractor's Application for Payment

14. Credit 16a-38k-4(b)(6) Carpet:

    1) Manufacturer's product data verifying that all carpet systems meet or exceed the testing and product requirements of the Carpet and Rug Institute Green Label Plus program.
    2) For carpet cushion, documentation indicating compliance with testing and product requirements of Carpet and Rug Institute's Green Label program
    3) Submit Product Data demonstrating that all adhesives and sealants do not exceed the allowable VOC limit.

15. Credit 16a-38k-4(b)(7) Composite Wood & Agrifiber: Maintain a list of each composite wood and agrifiber product installed in the building interior. Submittals for all composite wood and agrifiber products (including but not limited to particleboard, wheatboard, strawboard, agriboard products, engineered wood components, solid-core wood doors, and OSB, MDF, and plywood products) must include manufacturer's product data verifying that these products contain no urea-formaldehyde resins. This spreadsheet shall be submitted with each Contractor's Application for Payment

16. Credit 16a-38k-3(a) through Credit 16a-38k-4(f)(3): Maintain a list of permanently installed energy consuming products that are Energy Star compliant. Provide manufacturer verification of certification.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Contractor's designated HPB Credit Management Team, see section 1.8 below.
2. Commissioning Authority: The Commissioning Authority shall have documented commissioning experience in at least two building projects; be independent of the design and construction team; not employed by the design firm; not an employee of or contracted through contractor or firm holding construction contracts.

B. HPB Action Plans: Provide HPB Action Plan within 10 days after the Notice to Proceed and consistent with the requirements for pre construction submittals, prior to commencement of work to include the following:

1. Plan shall provide a detailed description of all activities that relate to accomplishing project HPB requirements, including construction practices, procurement practices, and proposed submittals and documentation for each HPB credit. Plan should also include:
   a. Name of individual[s] on Contractor's HPB Management Team responsible for ensuring HPB credits and prerequisites are earned and responsible for assembling documentation. The responsible party will be identified within 7 days after Notice to Proceed.
   b. Templates to be used for tracking HPB credits and listing of documents to be provided for each credit.
   c. HPB Materials Implementation Plan:
      1) Project Materials Cost Data: Provide a Plan consistent with the form attached hereto for HPB indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
         a) Furniture.
         b) Plumbing.
         c) Mechanical.
         d) Electrical.
         e) Specialty items such as elevators and equipment.
      2) The contractor shall supply this information using budget values to the project HPB Administrator on a bi-weekly basis beginning with the initial Action Plan and continuing every 2 weeks until completion of the HPB certification process. Include proposed materials, associated estimated costs, and details necessary for HPB calculations in order to determine if the listed materials can be expected to achieve the project goal. Submit initial materials implementation plans before materials purchasing begins.
      3) Material lists to be included in Implementation Plan are as follows:
         a) Credit 16a-38k-4(d)(8) and 16a-38k-4(d)(9): List of proposed materials with recycled content. Indicate cost, post-consumer recycled

content, and pre-consumer recycled content for each product having recycled content.

b) Credit 16a-38k-4(d)(10) and 16a-38k-4(d)(11): List of proposed regional materials. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.

c) Credit 16a-38k-4(d)(13): List of all proposed wood products and cost. Indicate each product containing certified wood, including its source and cost.

2. Credit 16a-38k-4(d)(4) and 16a-38k-4(d)(5) Recycle and Salvage Construction and Demolition Waste Plan: Waste management plan complying with Section 017419 "Construction Waste Management and Disposal."
3. Credit 16a-38k-3(e) Indoor Air Quality Management Plan: The contractor will supply the HPB administrator an IAQ Plan within 10 days after Notice to Proceed that, at a minimum, addresses the following:
   a. Periodic inspections of materials stored on-site to ensure that all installed or stored absorptive materials are protected from moisture and mold damage. If resting on the ground, spacers shall be provided to allow air to circulate between the ground and the materials. All water damaged materials shall be removed from the site and disposed of properly.
   b. Ductwork shall be sealed from the outside elements during transport and storage, and interior surfaces shall be wiped down immediately prior to installations. During installation, open ends of ductwork shall be temporarily sealed and ductwork shall be protected with surface wrapping. NO installed ductwork shall contain internal porous insulation materials or lining.
   c. HVAC equipment shall be covered and protected from moisture during transportation and on-site storage. For permanently installed air handlers used during construction, use filtration media in air handlers with a Minimum Efficiency Reporting Value (MERV) of ten. All filtration media shall be replaced immediately prior to building occupancy with media having a MERV rating of equal or greater value to existing media.
   d. Materials the off-gas toxic or potentially toxic fumes shall be preconditioned for at least seventy-two hours prior to installation within the building. Such materials shall also be installed prior to the installation of porous building materials. Prior to installation of porous materials and materials vulnerable to mold, the building enclosure shall be watertight.
   e. Adherence to SMACNA IAQ Guidelines for Occupied Buildings Under Construction, 2nd Edition 2007 Chapter 3.

C. HPB Progress Reports: Concurrent with each Contractor's Application for Payment or as specifically required in the individual specification sections, submit the following reports:

1. Credits 16a-38k-4(d)(8), 16a-38k-4(d)(9), 16a-38k-4(d)(10),16a-38k-4(d)(11), 16a-38k-4(d)(13): Materials Implementation Plan. Contractor shall use a materials spreadsheet, a sample form has been provided by HPB Administrator. Provide initial plan with HPB Action Plan and bi-weekly updates.
2. Credit 16a-38k-4(d)(4) and 16a-38k-4(d)(5): Waste reduction progress reports complying with Section 017419 "Construction Waste Management and Disposal."
3. Credit 16a-38k-3(e): Electronically dated photographs demonstrating compliance with IAQ plan.

4. Credit 16a-38k-4(d)(4) through 16a-38k-4(d)(7): Documentation illustrating compliance with low-emitting materials requirements.

1.7 CLOSEOUT SUBMITTALS

A. General: At completion of construction and prior to contract closeout, submit the following documentation in electronic format.
   1. Final Package per requirements of Division 01 Section "Construction Waste Management and Disposal.
   2. Final Package for 16a-38k-4(d)(8), 16a-38k-4(d)(9), 16a-38k-4(d)(10),16a-38k-4(d)(11), 16a-38k-4(d)(13): Provide individual electronic folders for each credit containing:
   3. Legible electronic copies of relevant material product data for each product listed on HPB Online Template.
   4. Final HPB Online Template including total project materials cost and a complete product list with costs demonstrating compliance with required level of achievement.
   5. Final Packages per requirements of Division 01 section "Indoor Air Quality Management."

C. HPB Online: Final HPB Online Template and associated required documentation uploaded to HPB Online Project Database for each of the following Credits:

   1. MR16a-38k-4(d)(4) and 16a-38k-4(d)(5), Construction Waste Management: As specified in Division 01Section"Construction Waste Management and Disposal."
   2. 16a-38k-4(d)(8), 16a-38k-4(d)(9), Recycled Content.
   3. 16a-38k-4(d)(10),16a-38k-4(d)(11), Regional Materials.
   4. 16a-38k-4(d)(13), Certified Wood.
   5. 16a-38k-3(e): IAQ plan

1.8 QUALITY ASSURANCE

A. HPB Coordinator Qualifications: Contractors shall engage a project team member or retained subconsultant, to coordinate all HPB requirements. HPB Coordinator shall demonstrate individual experience with at least 2 non-confidential LEED certified projects (citing previous work experience is acceptable).

B. Commissioning

   1. Perform commissioning Work as specified in Section 019113 – General Commissioning.

C. Perform Work to meet or exceed minimum energy efficiency and performance in accordance with project goals and targeted percent improvement over ASHRAE 90.1 2007.

D. Perform Work without use of CFCs, HCFCs, and Halons in HVAC and/or Plumbing Building systems.

E. Ensure adherence to IAQ plan and at a minimum provide electronically dated photographs and documentation that verify the following aspects of the IAQ plan with each application for payment and as applicable to construction phasing.

1. Comply with minimum requirements of SMACNA IAQ Guidelines for Occupied Buildings under Construction.
2. Protect stored and installed absorptive materials from moisture damage.
3. Store materials on elevated platforms under cover, and in dry location.
4. When materials are not stored in enclosed location, cover tops and sides of material with secured waterproof sheeting.
5. Protect HVAC equipment during construction. Seal ends of ductwork installed at end of each day. Keep ductwork sections sealed until ready to install..
6. Cover installed Grilles, Registers, and Diffusers until ready for use.
7. Shut down return side of HVAC system whenever possible during heavy construction or demolition.
8. When HVAC systems are operated during heavy construction, furnish disposable temporary filters.
9. Replace filtration media immediately before occupancy.

1.9 MATERIALS, GENERAL

A. Provide products and procedures necessary to obtain HPB credits required in this Section. Although other Specification Sections may specify some requirements that contribute to HPB credits, the project HPB Administrator shall determine additional materials and procedures necessary to obtain HPB credits indicated. Contractor shall provide all necessary documentation as determined by the HPB Administrator without additional time or cost to the Owner.

B. The percentage of HPB content value of materials for credits 16a-38k-4(d)(8), 16a-38k-4(d)(9), 16a-38k-4(d)(10),16a-38k-4(d)(11), 16a-38k-4(d)(13) are based upon total construction costs for CSI MasterFormat 2004 Edition Divisions 03-10, 316000, 321000, 323000, and 329000. Materials costs include all expenses to deliver the material to the site and include taxes and transportation costs incurred by the contractor but exclude labor and equipment once material has been delivered to the site. Contractor may use a default total materials cost (as defined by HPB) or actual materials cost.

C. The requirements specified in credits 16a-38k-4(b)(4) through16a-38k-4(b)(7) apply to all divisions and to all applications within the interior of the building, including interstitial spaces of the building envelope.

1.10 ENERGY STAR

A. Credit 16a-38k-3(a) through Credit 16a-38k-4(f)(3):Energy consuming products installed in the building shall be Energy Star compliant if the product category has an Energy Star specification.

1.11 REFRIGERANT

A. Credit 16a-38k-3(k) and 16a-38k-4(f)(1): The use of CFC-based refrigerants is not permitted. HVAC&R equipment must comply with the requirements set forth in HPB.

1.12 RECYCLED CONTENT OF MATERIALS

A. Credit 16a-38k-4(d)(9): Building materials shall have recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content for Project constitutes a minimum of 20 percent of cost of materials used for Project.

1. Cost of post-consumer recycled content plus one-half of pre-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content plus one-half of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
2. Do not include furniture, plumbing, mechanical and electrical components, and specialty items such as elevators and equipment in the calculation.

1.13 REGIONAL MATERIALS

A. Credit 16a-38k-4(d)(11): Not less than 20 percent of building materials (by cost) shall be regional materials. Provide materials that have been extracted, harvested, or recovered as well as manufactured within 500 miles (800 km) of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

1.14 CERTIFIED WOOD

A. Credit 16a-38k-4(d)(13): Not less than 50 percent (by cost) of wood-based materials shall be certified in accordance with the current FSC principles and criteria. Suppliers and products must be certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship." The contractor shall provide Chain-of-Custody Certificates, certificates signed by manufacturers certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body. Certificates shall include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body

1. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:

   a. Rough carpentry.
   b. Miscellaneous carpentry.
   c. Heavy timber construction.
   d. Wood decking.
   e. Metal-plate-connected wood trusses.
   f. Structural glued-laminated timber.
   g. Finish carpentry.
   h. Architectural woodwork.
   i. Wood paneling.
   j. Wood veneer wall covering.
   k. Wood flooring.
   l. Wood lockers.
   m. Wood cabinets.
   n. Wood windows

o. Flush wood doors
p. Stile and rail wood doors

1.15 LOW-EMITTING MATERIALS

A. Credit 16a-38k-4(b)(4): For field applications that are within the interior of the building, including interstitial spaces of the building envelope, and applied on-site, adhesives and sealants shall comply with one of the programs listed below. The contractor shall provide confirmation of product certification, including but not limited to Material Safety Data Sheets. Documentation shall be provided to the HPB administrator for approval prior to product procurement.
   1. Scientific Certification Systems- Indoor Advantage –Gold
   2. GREENGUARD Certification Program
   3. Green Seal- GS-36

B. Credit 16a-38k-4(b)(5): For field applications that are within the interior of the building, including interstitial spaces of the building envelope, and applied on-site, paints and coatings shall comply with one of the programs listed below. The contractor shall provide confirmation of product certification, including but not limited to Material Safety Data Sheets. Documentation shall be provided to the HPB administrator for approval prior to product procurement.
   1. Scientific Certification Systems- Indoor Advantage –Gold
   2. GREENGUARD Certification Program
   3. Green Seal- GS-11

C. Credit 16a-38k-4(b)(6): Carpet: All Carpet and carpet cushion installed must meet requirements of Carpet and Rug Institute Green Label Plus Program. All carpet adhesive must meet the requirements of 16a-38k-4(b)(4): Adhesives and Sealants. The contractor shall provide confirmation of product certification, including but not limited to Material Safety Data Sheets. Documentation shall be provided to the HPB administrator for approval prior to product procurement.

C. Credit 16a-38k-4(b)(7): Composite wood, agrifiber products, and adhesives shall not contain urea-formaldehyde resin. Contractor shall provide confirmation all composite wood and agrifiber products used within the shell of the building meets the California Department of Health Services Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 addenda. Alternatively, the Contractor may provide manufacturer verification products do not contain added urea-formaldehyde resins. Documentation includes but is not limited to MSDS.

PART 3-EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

A. Credit 16a-38k-4(d)(5): Comply with Section 017419 "Construction Waste Management and Disposal."

3.2 CERTIFIED WOOD

A. Credit 16a-38k-4(d)(13): The contractor shall verify and coordinate the use of all wood products specified as FSC certified.

3.3 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

A. Credit 16a-38k-3(e): Comply with mandatory HPB provisions and SMACNA's IAQ Guidelines for Occupied Buildings under Construction, 2nd edition, 2007, ANSI/SMACNA 008-2008, Chapter 3 including the following:

1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Section 015000 "Temporary Facilities and Controls," install filter media having a MERV 10 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
2. Replace all air filters immediately prior to Owner occupancy.

END OF SECTION 018113.13

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Coordinate with the Earthwork and Dampproofing Sections of the Specifications to ensure that all selected fill and polyethylene vapor barriers have been placed as specified prior to placing slabs on earth.

C. Coordinate with Concrete Formwork, Expansion and Contraction Joints, Concrete reinforcement, Specialty-Finished Concrete, and other appropriate Sections of the Specifications to ensure that proper provisions for and contingent to cast-in-place concrete are performed prior to placing of the concrete specified herein.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Footings, Walls, Columns
   2. Slabs-on-grade.
   3. PT slab
   4. Composite slab construction with steel deck.
   5. Equipment pads and bases.
   6. Fill for steel pan stairs.

B. Related Sections:
   1. Section 03 35 00 “Concrete Finishing”.
   2. Section 03 53 00 "Concrete Topping" for concrete floor toppings.
   3. Section 05 31 00 “Steel Decking” for steel deck construction.
   4. Section 31 20 00 "Earth Moving" for drainage fill under slabs-on-grade.
   5. Section 32 13 13 "Concrete Paving" for concrete pavement and walks.
   6. Div. 01, High Performance Buildings Requirements Section 018113.13 for credits16a-38k-4(d)9,16a-38k-4(d)11,16a-38k-4(b)4:
      1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.2-1.05.02 and NOTICE TO CONTRACTOR-SUMITTALS.

B. Product Data: For proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others if requested by the Owner.

C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Comply with ACI 315 "Manual of Standard practice for Detailing Reinforced Concrete Structures" showing bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Include special reinforcing required for openings through concrete structures. SD works should be prepared by or under supervision of qualified professional engineer register in the Connecticut state.

E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer that has a record of successful in-service performance and who is legally authorized to practice in the jurisdiction where Project is located detailing fabrication and erection of forms for specific finished concrete surfaces. Show form construction including joining, special form joints or reveals, location and pattern of form tie placement, and other items that affect exposed concrete visually.

1. Owner's review is for general architectural applications and features only. Designing formwork for structural stability and efficiency is Contractor's responsibility.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: In lieu of material laboratory test reports when permitted by the Owner. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

B. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

D. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. ACI Publications: Comply with the latest editions of the following unless modified by requirements in the Contract Documents:

ACI 301, "Specifications for Structural Concrete," Sections 1 through 5 and Section 7, "Lightweight Concrete."
ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
ACI 318, “Building Code Requirements for Reinforced Concrete.”
ACI 347, “Guide to Formwork for Concrete.

ACI 305R, "Hot Weather Concreting."
ACI 306R, "Cold Weather Concreting."
ACI 523.1R, “Guide for Cast-in-Place Low Density Concrete.”
ASTM C138, “Standard Test Method for Unit Weight, Yield, and Air Content of Concrete.”
ASTM C150, “Standard Specification for Portland Cement.”
ASTM C311, “Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete.”
ASTM C494, “Standard Specification for Chemical Admixtures for Concrete.”
ASTM C495, “Standard Test Methods for Compressive Strength of Lightweight Insulating Concrete.”
ASTM C496, “Standard Test Methods for Splitting Tensile Strength of Cylindrical Concrete Specimens.”
ASTM C513, “Standard Test Methods for Securing, Preparing, Obtaining, and Testing Specimens of Hardened Lightweight Insulating Concrete for Compressive Strength.”
ASTM C796, “Standard Method of Testing Foaming Agents for Use in Producing Cellular Concrete Using Preformed Foam.”
ASTM C869, “Standard Specification for Foaming Agents for Use in Making Preformed Foam for Cellular Concrete.”

2. Concrete Reinforcing Steel Institute (CRSI): “Manual of Standard Practice.”

E. Concrete Testing Service: The Owner will engage a qualified independent testing agency, approved by the Owner, who will make all concrete compression tests on the Project according to the standards described and listed in the “Field Quality Control” article of this Specification.

1. The costs of sampling and testing of cast-in-place concrete shall be paid for by the Owner.
2. The Contractor shall notify the testing laboratory, as selected by the Owner, 24 hours prior to each placing of concrete so that arrangements can be made for testing.

F. Preinstallation Conference: When directed by Owner, conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

Contractor's superintendent.
Independent testing agency responsible for field quality control.
Ready-mix concrete manufacturer.

Concrete subcontractor.
Special concrete finish subcontractor.
Structural engineer.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on the Drawings.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

High-density overlay, Class 1 or better.
B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

D. Form-Release Agent: Commercially formulated form-release agent with a maximum of 350 g/L volatile organic compounds (VOC's) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

E. Form Ties: Factory-fabricated, removable or snap-off metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1-1/2 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Plain-Steel Wire: ASTM A 82/A 82M, as drawn.

C. Deformed-Steel Wire: ASTM A 496/A 496M, flat sheet.

D. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

E. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

2.3 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For slabs on grade, use supports with sand plates or horizontal runners where base material will not support chair legs. Use supports that will not puncture vapor barrier/retarder.

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project unless otherwise acceptable to the Owner:

1. Portland Cement: ASTM C 150, Type I. Contractor may use Type III cement in concrete as approved by the Owner. Supplement with the following:

Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Silica Fume: ASTM C 1240, amorphous silica., proportioned in accordance with ACI 211.1

C. Normal-Weight Aggregates: ASTM C 33, coarse aggregate or better, graded, with a total water soluble chloride ion content below 0.02 percent. Provide aggregates from a single source for exposed concrete.

1. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling.
2. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to the Owner.

D. Lightweight Aggregate: ASTM C 330.

E. Water: ASTM C 94/C 94M, clean, potable, and free from injurious amounts of oil, alkali, organic matter, or other deleterious material.

2.5 ADMIXTURES

A. General: Provide concrete admixtures that contain less than 0.1 percent chloride ions.

B. Air-Entraining Admixture: ASTM C 260, ready-to-use air-entraining admixture formulated to improve stability of air entrainment, to increase resistance to damage from freeze/thaw cycles, and to scaling from de-icing salts, reduced permeability for increased watertightness, reduced segregation and bleeding, and improved plasticity and workablility, certified by manufacturer to be compatible with other required admixtures.

1. Products: Subject to compliance with requirements, provide one of the following:

BASF Corporation – Admixture Systems; Micro Air, MB-VR, or MB-AE 90.
Euclid Chemical Company (The), an RPM company; EUCON BCN.
Grace Construction Products, W. R. Grace & Co.

C. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A, ready-to-use water-reducing liquid admixture formulated for flat and cast concrete work, to improve workability, reduce segregation, improve finishing characteristics, increase compressive and flexural strength, and not initiate or promote corrosion of reinforcing.

Products: Subject to compliance with requirements, provide one of the following:

- BASF Corporation – Admixture Systems; Pozzolith Series or PolyHeed Series.
- Euclid Chemical Company (The), an RPM company; WR-75 or WR-91.
- Grace Construction Products, W. R. Grace & Co.

2. Retarding Admixture for Hot Weather: ASTM C 494/C 494M, Type B and D, ready-to-use, liquid admixture, formulated for concrete work to retard setting time, and facilitate placing and finishing.

1) Products: Subject to compliance with requirements, provide one of the following:

- BASF Corporation – Admixture Systems; Pozzolith Series or PolyHeed Series.
- Euclid Chemical Company (The), an RPM company; WR-75 or WR-91.
- Grace Construction Products, W. R. Grace & Co.

3. Non-Corrosive Accelerator for Cold Weather: ASTM C 494/C 494M, Type C and E**,** ready-to-use, non-chloride, liquid admixture formulated for concrete work to accelerate setting time, and increase early and ultimate strengths across a wide range of cold weather and sub-freezing temperatures.

1) Products: Subject to compliance with requirements, provide one of the following:

* BASF Corporation – Admixture Systems; Pozzutec 20+ or Pozzolith NC 534.
* Euclid Chemical Company (The), an RPM company.
* Grace Construction Products, W. R. Grace & Co.

4. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
5. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
6. High-Range, Water-Reducing Admixture for Cold Weather: ASTM C 494/C 494M, Type F, high-range, water-reducing admixture formulated to aid in the production of concrete with the following qualities in a plastic state:

   1) Plasticity range of 6inches to 9 inches.

   2) Normal setting characteristics.

   3) Extended slump retention.

   4) Controlled time of set.

   5) Cohesive and non-segregating.

   6) Minimal bleed water.

   In a hardened state, admixture shall provide the following engineering properties:

   1) Higher, earlier strengths than can be achieved with conventional superplasticizers.

   2) Increased ultimate compressive strength.

   3) Higher modulus of elasticity.

   4) Improved bond strength to steel.

   5) High durability.

   6) Reduced shrinkage and creep.

   7) Highly reliable in-place structural integrity.

Typical Locations: Columns, elevated slabs, walls for temperatures 85 deg F and below.
Products: Subject to compliance with requirements, provide one of the following:

- BASF Corporation – Admixture Systems; Rheobuild 1000 or Glenium Series.

- Euclid Chemical Company (The), an RPM company; Eucon 37.

- Grace Construction Products, W.R. Grace & Co.

7. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
8. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
9. Workability-Retaining Admixture: ASTM C 494/C 494M, Type S.

Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) BASF Corporation – Admixture Systems; RheoTEC Z-60.

2) Euclid Chemical Company (The), an RPM company; EUCON BCN or EUCON CIA.

3) Grace Construction Products, W. R. Grace & Co.

D. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C. Add to all concrete receiving traffic (SOG and topping)

1. Products: Subject to compliance with requirements, provide one of the following:

BASF Corporation – Admixture Systems; Rheocrete CNI.
Euclid Chemical Company (The), an RPM company; EUCON BCN or EUCON CIA.
Grace Construction Products, W. R. Grace & Co.; DCI.

2.6 FIBER REINFORCEMENT

A. Synthetic Micro-Fiber: Monofilament or fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, not less than 3/4 inch long.

1. Products: Subject to compliance with requirements, provide one of the following:

Monofilament Micro-Fibers:

- BASF Corporation – Admixture Systems; MasterFiber M Series.
- FORTA Corporation; FORTA Econo-Mono.
- Grace Construction Products, W. R. Grace & Co.; Grace.

B. Fibrillated Micro-Fibers:

- BASF Corporation – Admixture Systems; MasterFiber F Series.
- FORTA Corporation; FORTA Econo-Net.
- Grace Construction Products, W. R. Grace & Co.; Grace Fibers.

2.7 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   - Greenstreak.
   - Williams Products, Inc.
   - Vinylex Corp.

2. Profile: Flat, dumbbell-type or center-bulb type waterstops.

B. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   - Greenstreak.
   - Paul Murphy Plastics Company.
   - Vinylex Corp.
2. Profile: Flat, dumbbell-type or center-bulb type waterstops.

C. RX-Bentonite Waterstop: Furnish and install expanding bentonite-based waterstops , illustrated on the project drawings and comply with waterproofing section 071000.

2.8 VAPOR RETARDERS

A. Vapor Retarders: Provide vapor retarder that is resistant to deterioration when tested according to ASTM E 154, as follows:

1. Water-resistant barrier consisting of heavy kraft papers laminated together with glass-fiber reinforcement and overcoated with black polyethylene on each side.

B. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Products: Subject to compliance with requirements, provide one of the following:
   - Fortifiber Building Systems Group; Moistop Ultra 15.
   - Raven Industries Inc.; Vapor Block 15.
   - Reef Industries, Inc.; Griffolyn 15 mil Green.

C. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

D. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

E. Sand Cushion: Clean, manufactured, or natural sand.

2.9 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing No. 4 (4.75-mm) sieve. This product shall be used at maintenance area.

1. Available Products:
   - Anti-Hydro International, Inc.; Emery.
   - Dayton Superior Corporation; Emery Non-Slip.
   - Emeri-Crete, Inc.; Emeri-Topcrete.

B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.

1. Available Products:
   - Anti-Hydro International, Inc.; A-H Alox.
   - L&M Construction Chemicals, Inc.; Grip It AO.
   - Sonneborn, Div. of ChemRex; Frictex NS.

C. Emery Dry-Shake Floor Hardener: Unpigmented, factory-packaged, dry combination of portland cement, graded emery aggregate, and plasticizing admixture; with emery aggregate consisting of no less than 60 percent of total aggregate content. This product shall be used at Bus Traffic Pass on the 1st level shown on the sheet S-125, class 5 finish. The contractor is to sit pre-installation conference including the manufacturer Rep and his attendant at first application on the site.
   1. Color: As selected by Architect from manufacturer's full range.
   2. Available Products:
      - L&M Construction Chemicals, Inc. Emeryplate FF
      - Sika Construction, Sikafloor-1 Metaltop.
      - Dayton Superior, Emery Tuff.

D. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.
   1. Available Products:
      - Burke by Edoco; Titan Hard.
      - ChemMasters; Chemisil Plus.
      - ChemTec International; ChemTec One.

2.10 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

B. Curing Paper: Provide regular reinforced composite kraft paper complying with ASTM C 171. Polyethylene film and burlene are not permitted.

C. Non-Insulated Curing Tarp: Provide reusable polypropylene (PP) or vinyl-caoted polyester covers by one of the following:
   1. Hamilton Form Company, Ltd.; Tarps.
   2. Reef Industries, Inc.; Transguard 4000.
   3. ChemTec International; ChemTec One

D. Insulated Curing Blankets: To prevent frost during cold weather pours, provide reusable polypropylene (PP) or vinyl-coated polyester covers having fully-bonded, closed-cell insulation core by one of the following:
   1. Hamilton Form Company, Ltd.; Concrete Curing Blankets.
   2. TVM Building Products; TVM Concrete Curing Blankets.
   3. ChemTec International; ChemTec One

E. Water: Provide fresh, clean, potable water free of oil, grease, waxy films, curing compounds, release agents and other deleterious materials that would negatively affect the quality, durability, and performance of the concrete.

F. Liquid Membrane-Forming Curing Compounds, General:

1. Select liquid membrane-forming curing compounds that produce a uniform, continuous, adherent film that does not check, crack, or peel, and dry or cure free of pinholes or other imperfections.
2. On permanently exposed surfaces, provide clear-type liquid membrane-forming curing compounds having a fugitive dye, which are non-discoloring, fast-drying, and are evidenced to not darken or yellow with age.
3. On concrete floors scheduled to receive an adhered covering, provide liquid membrane-forming curing compounds specially formulated for proposed adhesives and certified by the compound manufacturer not to inhibit the bonding qualities of selected flooring adhesives.
4. Do not apply liquid membrane-forming curing compounds on concrete scheduled to either receive or bond to concrete or mortar, nor on slabs scheduled to receive elastomeric or bituminous type coatings, or bituminous sheet waterproofing.

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Description: Apply nondissipating curing compounds to interior concrete slabs that will later receive resilient flooring, concrete toppings, epoxy or urethane based coatings, penetrating concrete sealer.
2. Products: Subject to compliance with requirements, provide one of the following:

BASF Corporation – Building Systems; Kure-N-Seal WB.
Euclid Chemical Company (The), an RPM company; Aqua Cure VOX; Clearseal WB 150.
L&M Construction Chemicals, Inc.; Dress & Seal WB.

H. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Description: Apply nondissipating curing compounds to interior concrete slabs that will later receive resilient flooring, concrete toppings, epoxy or urethane based coatings, penetrating concrete sealer.
2. Products: Subject to compliance with requirements, provide one of the following:
   - BASF Corporation – Building Systems; Kure-N-Seal W.
   - Euclid Chemical Company (The), an RPM company; Diamond Clear VOX; Clearseal WB STD.
   - L&M Construction Chemicals, Inc.; Dress & Seal WB.

I. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Description: Apply membrane-forming curing and sealing compounds to interior concrete slabs within telecommunications, low voltage, and electrical rooms.
2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   - BASF Corporation – Building Systems; Kure 1315.
   - L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
   - Meadows, W.R., Inc.; Vocomp-30.

3. VOC Content: Curing and sealing compounds shall not exceed the VOC limits established in South Coast Air Quality Management District (SCAQMD) Rule 1113. Architectural Coatings, rules in effect on July 1, 2008.

2.11 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, non-load bearing, and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

D. Reglets: Where sheet flashing or bituminous membranes are terminated in reglets, fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

E. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.12 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.

4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.
5. Products: Subject to compliance with requirements, provide the following:
   - Ardex Engineered Cements; Ardex K-500 Self-Leveling Concrete Topping.
   - Euclid Chemical Company (The), an RPM company; Diamond Clear VOX; Clearseal WB STD.
   - L&M Construction Chemicals, Inc.; Dress & Seal WB.

2.13 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
   2. Do not use the same testing agency for field quality control testing.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Pozzolan: 25 percent.
   2. Ground Granulated Blast-Furnace Slag: 50 percent.
   3. Combined Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with pozzolan not exceeding 25 percent.
   4. Silica Fume: 10 percent.
   5. Combined Pozzolans and Silica Fume: 35 percent with pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
   6. Combined Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Submit written reports to Owner of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Owner.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.02 percent by weight of cement.

E. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
   4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.14 DESIGN MIXES

A. Design Mixes to provide normal weight concrete with the following properties as indicated on Drawings and schedules:

1. Minimum Compressive Strength: 5000 psi at 28 days.
Maximum Water-Cementitious Materials Ratio: 0.40 (non-air-entrained); 0.35 (air-entrained). Typical concrete U.O.N.
2. Minimum Compressive Strength: 4000 psi at 28 days.
Maximum Water-Cementitious Materials Ratio: 0.44 (non-air-entrained); 0.35 (air-entrained). Foundation concrete.
3. Minimum Compressive Strength: 3500 psi at 28 days.
   a.Maximum Water-Cementitious Materials Ratio: 0.50 (non-air-entrained); 0.40 (air-entrained). SOG of area D only.
4. Minimum Compressive Strength: 2500 psi at 28 days.
a.Maximum Water-Cementitious Materials Ratio: 0.67 (non-air-entrained); 0.54 (air-entrained). Lean concrete.

B. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) rations as follows:
1. Subjected to freezing and thawing: W/C 0.45 max.
2. Subjected to deicers/watertight: W/C 0.40 max.
3. Subjected to brackish water, salt spray or deicers: W/C 0.40 max.

C. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
1. Ramps, Slabs, and Sloping Surfaces: Not more than 3 inches.
2. Reinforced Foundation Systems: Not less than 1 inch and not more than 3 inches.
3. Concrete Containing High-Range Water-Reducing Admixture (Superplasticizer): Not more than 8 inches after adding admixture.
4. Other Concrete: Not more than 4 inches.

D. Lightweight Structural Concrete: Lightweight aggregate and concrete shall conform to ASTM C 330. Proportion mix to produce concrete with a minimum compressive strength of 4000 psi at 28 days and a calculated equilibrium unit weight of 110 pcf plus or minus 3 pcf as determined by ASTM C 567. Concrete slump at the point of placement shall be the minimum necessary for efficient mixing, placing, and finishing. Maximum slump shall be 6 inches for pumped concrete and 5 inches elsewhere. Air-entrain concrete exposed to weather according to ACI 301 requirements.

E. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Owner. Laboratory test data for revised mix design and strength results must be submitted to and accepted by owner before using in Work.

F. Fiber Reinforcement: Add at manufacturer’s recommended rate but not less than 1.5 lb per cu. yd.

2.15 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.16 ADMIXTURES

A. Use air-entraining admixtures in exterior exposed concrete, structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent within the following limits:

1. Standard Weight Concrete: The air content in all concrete exposed to weathering shall be maintained at 5% + or 1-1/2% for ground level exterior work. Other concrete exposed to weathering shall be 3% more or less 1- 1-1/2%. All slabs which are to receive a dust coat surface hardener shall have an air content not to exceed 3%.
2. Lightweight Concrete: The air content in all lightweight concrete exposed to weathering shall be maintained at 7-1/2% ± 1-1/2%.

B. Rate of Hardening:

1. Under 50 degrees F, Ambient Temperature
2. Over 90 degrees F, Ambient Temperature
3. Between 50 degrees F and 90 degrees F.

2.17 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

2.18 Precast Concrete Manhole (sump pit): ASTM C 478, precast reinforce concrete, of depth indicated, with frame, cover, and rubber gasket joints.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordinate the installation of joint materials, vapor retarder/barrier, and other related materials with placement of forms and reinforcing steel.

3.2 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
    1. Class A, 1/8 inch for smooth-formed finished surfaces exposed to view.
    2. Class C, 1/2 inch for other concrete surfaces.

D. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in the Work. Solidly butt joints and provide backup at joints to prevent cement paste from leaking.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms where slope is too steep to place concrete with bottom forms only, for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
    1. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
    2. Do not use rust-stained steel form-facing material.

F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible before and during concrete placement. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

G. Chamfer exterior corners and edges of permanently exposed concrete to produce uniform smooth lines and tight edge joints.

H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

I. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

J. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.3 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.4 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
   1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
   2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Owner.

3.5 SHORES AND RESHORES

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
   1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.6 VAPOR RETARDERS

A. Place vapor retarder in position with longest dimension parallel with direction of pour, according to ASTM E 1643 and manufacturer's written instructions.
   1. Lap joints 6 inches and seal with manufacturer's recommended mastic or pressure-sensitive tape.

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

C. Cover vapor retarder with sand cushion, and compact to depth indicated.

3.7 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with metal chairs, runners, bolsters, spacers, and hangers as approved by Owner

D. Place reinforcement to maintain minimum concrete cover as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

G. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

H. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

3.8 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Owner.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
   2. Provide keyways at least 1-1/2 inches deep into construction joints in walls and slabs and between walls and footings. Bulkheads designed and accepted for this purpose may be used for slabs.

3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction (Control) Joints in Slabs-on-Grade: Form contraction joints in slabs-on-grade to form patterns as indicated. Use saw cuts 1/8-inch- wide by one-fourth of slab depth or inserts 1/4 inch wide by one-fourth of slab depth, unless otherwise indicated.
1. Form contraction joints by inserting premolded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
2. Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.
3. If joint pattern is not shown, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).
4. Joint fillers and sealants are specified in Section 07 92 00 “Joint Sealants.”

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 07 92 00 "Joint Sealants," are indicated.
2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.9 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.10 PREPARING FORM SURFACES

A. General: Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before placing reinforcement.

B. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.

3.11 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed. Notify other trades to permit installation of their work.

B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation at its final location.

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Placing Concrete Slabs: Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Bring slab surfaces to correct level with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature has fallen or is expected to fall below 40 deg F for three successive days, uniformly heat water and aggregates before mixing to obtain a concrete mix temperature of not less than 50 degrees F (10 degrees C) and not more than 80 degrees F (27 degrees C) at point of placement, or as recommended by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 301 and as follows:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
4. Use water-reducing admixtures when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Owner.

3.12 FINISHING FORMED SURFACES

A. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

B. Smooth-Formed Finish: Provide a smooth-formed finish on formed concrete surface exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or another similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed. No form ties should be used at exposed to view concrete surface.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
1. Grout-Cleaned Finish: Provide grout-cleaned finish on scheduled concrete surfaces that have received smooth-formed finish treatment.

Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of acrylic or styrene butadiene-based bonding admixture and water to form the consistency of thick paint. Blend standard Portland cement and white portland

cement in amounts determined by trial patches so that final color of dry grout will match adjacent surfaces.
Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep surface damp by fog spray for at least 36 hours after rubbing.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.13 MONOLITHIC SLAB FINISHES

A. General: Concrete faces shall be finished in accordance with the following methods. The type of surface finish required on the structure or various portions of the building shall be as indicated on the Drawings. Strict compliance with the Specifications and their intent pertaining to finished surface shall be insisted on. Any surfaces of defective finish will not be accepted, until finishing has been completed in conformity with the Specifications. All concrete surfaces on which a rubbed finish is specified shall be finished within twenty-four hours after the forms are removed.

1. Ordinary Surface Finish: Immediately following the removal of forms all fins and irregular projections shall be removed from all surfaces except from those which are not to be exposed or not to be waterproofed. On all surfaces, the cavities produced by form ties and all other holes, honeycomb spots, broken corners or edges, and other defects shall be thoroughly cleaned, and after having been kept saturated with water for a period of not less than three hours shall be carefully pointed and trued with mortar of cement and fine aggregate mixed in the proportions used in the grade of the concrete being finished. Mortar used in pointing shall be not more than one hour old. Any excess mortar at the surface of the concrete due to filling from tie holes shall be struck off flush with a cloth. The mortar patches shall be cured as specified under “Concrete Curing and Protection” article in Part 3 of this Section. All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges. The resulting surfaces shall be true and uniform. Al surfaces which cannot be repaired to the satisfaction of the Owner shall be “rubbed” as specified for rubbed surface finish.
2. Rubbed Surface Finish: As soon as the pointing has set sufficiently the entire surface shall be thoroughly wet with a brush and rubbed with a No. 6 carborundum stone or an abrasive of equal quality, bringing the surface to a paste. The rubbing shall be continued sufficiently to remove all form marks and regular projections, producing a smooth dense surface without pits or irregularities. The material which, in the above process has been ground to a paste, shall now be carefully spread or brushed uniformly over the entire surface and allowed to take a “reset.” The final finish shall be obtained by a thorough rubbing with a No. 10 carborundum stone or abrasive of equal quality. This rubbing shall continue until the entire surface is of a smooth texture and uniform in color.
3. Brush Finish: After the concrete has been struck off, the surface shall be thoroughly worked and floated with a wooden, canvas, or cork float, the

operation to be performed by skilled and experienced concrete finishers. Before this last finish is set, the surfaces shall be lightly striped with a fine brush to remove the surface cement film, leaving a fine-grained, smooth, but sanded texture.

4. Steel Trowel Finish: Steel trowel finish shall be produced by lightly tamping concrete to force coarse aggregate away from the surface then screed to proper level, providing a reasonably smooth surface. When water sheen has disappeared from the surface, concrete shall be floated and lightly trowelled. When concrete has set sufficiently to ring under the trowel, it shall be given a second steel troweling to produce a smooth, level, dense surface. Care shall be taken not to over trowel while the concrete is wet, causing an excessive amount of fines to be brought to the surface. Sufficient time shall be allowed for excess surface water to disappear. Dry cement or mixture or cement and sand shall not be sprinkled directly on slab. Particular attention shall be given to curing slabs as specified herein.

B. Prevention and Removal of Stains on Concrete: The Contractor shall prevent rust of structural steel, staining by bituminous materials or any other substance from discoloring and portion of the concrete. The Contractor, therefore, shall devise and use construction procedures or methods that prevent staining of any of the concrete. If, however, any portion of the concrete is stained, the Contractor shall remove such stains and restore the concrete to its original color without damage to the concrete all at his expense and approved by the Owner.

C. Unspecified Finishes: When the type of finish is not specified on the Drawings, the following finishes shall be used as applicable:

1. Brushed Finish: For sidewalks, garage floors, ramps (interior and exterior), exterior platforms, exterior steps and landings.
2. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin film-finish coating system.

Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and finish surfaces to tolerances of F(F) 20 (floor flatness) and F(L) 17 (floor levelness) measured according to ASTM E 1155. Grind smooth any surface defects that would telegraph through applied floor covering system.

1. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply a trowel finish as specified, then immediately follow by slightly scarifying the surface with a fine broom.
2. Nonslip Broom Finish: Apply a nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route.
3. Coordinate required final finish with Owner before application.

D. Finishing Tolerances:

1. Brush Finishes: Surfaces scheduled to receive either a float or brush finish shall be true planes within 1/4 inch in 10 feet, as determined by a 10 foot straightedge placed anywhere on the slab in any direction.
2. Steel Trowel Finish: Surfaces scheduled to receive either a steel trowel or hardened finish shall be true planes within 1/8 inch in 10 feet, as determined by a 10 foot straight edge placed anywhere on the slab in any direction.

E. Construction Joints: The use and location of monolithic construction joints shall be indicated on Shop Drawings and subject to prior approval by the owner. In general, they shall be in accordance with the following:

1. Preparation of Joints: The surface of the concrete shall be roughened, thoroughly cleaned, and all laitance removed. In addition to the foregoing, joints shall be thoroughly wetted and slushed with coat of neat cement grout immediately before placing of new concrete.
2. Joints Between Horizontal Members and Walls or Columns: At least two hours must elapse after depositing concrete in columns or walls before depositing in beams, girders, or slabs supported thereon. Beams, girders, brackets, column capitals, and haunches shall be considered as part of the floor system and shall be placed monolithically unless otherwise specifically indicated on the plans.
3. Joints in Horizontal Members: Construction joints in floors shall be located in the middle one-third of the spans of slabs, beams, or girders, unless a beam interacts a girder at this point, in which case the joints in the girders shall be offset a distance equal to twice the width of the beam. Provision shall be made for shear by use if inclined reinforcement.

3.14 DEFECTIVE CONCRETE WORK

A. Porous areas, open or porous construction joints and honey-combed concrete indicate that all the requirements for mixing, placing, and handling have not been complied with and shall be considered as sufficient cause for rejection of the members of the structure thus affected. Defective work exposed upon removal of forms shall be entirely removed or repaired as required within 48 hours after forms have been removed.

B. No repaired area will be accepted unless:

1. The structural requirements have not been impaired by reducing the net section of compression members.
2. The bond between the steel and the concrete has not been reduced.
3. The areas shall be finished so as to conform in every respect to the texture, contour, and color of the surrounding concrete.

C. If the above limitations cannot be satisfied, the members or unit involved shall be removed and satisfactorily replaced entirely at the Contractor’s expense.

D. Defective areas shall be cut out to such depth that all voids, honeycomb, or other defect shall be entirely removed. The edges of the material remaining in place shall be cut perpendicular to the finished surface to the full depth of the material removed but not less than one inch.

E. If the removal of defective concrete affects the structural requirements as above defined, the member likewise shall be removed and replaced.

F. The area to be repaired and a space at least 5 inches wide entirely surrounding it shall be wetted to prevent absorption of water from the patching mortar. The patch shall be made with mortar, the mix of which shall be predetermined by making trial batches to secure mix matching the color and texture of surrounding concrete. The use of light colored or white Portland cement will be permitted in order to facilitate color matching. The amount of water used in mixing the mortar shall be as little as is consistent with the requirements of handling and placing. The mortar shall then be put aside for one hour during which time it shall be mixed with a trowel to

prevent settling. No additional water shall be added to the mix. The area being repaired shall be thoroughly cleaned and brush coated with a slurry coat of one part Portland cement and one part sand. The mortar shall be thoroughly compacted in place and screeded off so as to leave the patch slightly higher than the surrounding area. It shall then be left undisturbed for a period of one to two hours to permit initial shrinkage before being finally finished. The patch shall be finished in such a manner as to match the adjoining surface. On surfaces where unlined forms have been used the final finish shall be obtained with straightedge spanning the patch and held parallel to the direction to the form marks. After the patches have set sufficiently so that the surface will not be damaged curing and protection of concrete shall proceed as specified herein.

3.15 ACCEPTANCE OF CAST-IN-PLACE CONCRETE

A. Acceptance of cast-in-place concrete shall be in accordance with Chapter 18 of ACI 301.

3.16 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Provide concrete sealant on all electrical housekeeping pads and in all electrical rooms.

E. Provide concrete sealant on all mechanical housekeeping pads.

F. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in safety inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.17 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

D. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

E. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

F. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Provide moisture curing by the following methods:

Keep concrete surface continuously wet by covering with water. Accomplishments by use of mechanical sprinklers and standard portable tap water.

Cover concrete surface with specified absorptive cover, water saturated, and kept continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4 inch lap over adjacent absorptive covers.

1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 3 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
2. Curing Compound: Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as follows:

Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete and conforming to ASTM C 309.

1. Saturated Sand Curing: Sand for saturated sand curing shall be clean, sharp natural sand, containing no deleterious material that will stain the concrete.
2. Curing Paper: Waterproof paper conforming to ASTM C 171 or opaque polyethylene.

3.18 REUSING FORMS

A. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use patched forms for exposed concrete surfaces except as acceptable to Owner.

3.19 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas with cement mortar immediately after removing forms when approved by the Owner. Remove and replace concrete that cannot be repaired and patched to Owner's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

1. For surfaces exposed to view, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

C. Repairing Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Owner. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with dry-pack mortar or precast cement cone plugs secured in place with bonding agent.

1. Where possible, repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Owner. If defects cannot be repaired, remove and replace the concrete.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.

1. Repair finished unformed surfaces containing defects that affect the concrete’s durability. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas in unformed surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to the Owner.
4. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
5. Repair isolated random cracks and single holes 1 inch or less in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place dry-pack before bonding agent has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, with Owner's approval for methods and procedure, using specified epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Owner's approval.

3.20 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Special Inspections: Special Inspections required are enumerated in the Schedule of Special Inspection Services contained in Section 014100.

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain samples from the first three (3) batches at the start of placement for each day's pour of each concrete mixture exceeding 5 cu. Yd., plus one (1) set for each additional 50 cu. Yd. or fraction thereof.

Should any portion of required testing and/or batch time not meet specified requirements, the concrete batch in question shall be rejected. Testing shall then be performed until three (3) consecutive batches of concrete meets all specified requirements, including batch time. Testing shall return to the specified frequency only when all testing requirements have been satisfied for there (3) consecutive batches of concrete.

All appropriate parties shall be notified immediately of each failed test.

Additional testing required due to concrete not meeting specified requirements shall be performed at contractors expense.

When frequency of testing will provide fewer than five composite samples of each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if few than five are used.

Slump: ASTM C 143/C 143M; one test at point of placement for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

Air Content: ASTM C 231, pressure method, for lightweight or normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each day's pour of each type of air-entrained concrete

Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.

Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

Compression Test Specimens: AST C 31.

Cast and laboratory cure one set of four standard cylinder specimens for each composite sample.

Cast and field cure one set of four standard cylinder specimens for each composite sample.

Compressive-Strength Tests: ASTM C 39; for each set, test one specimen at 7 days, two specimens at 28 days, and hold one specimen in reserve for later testing if required.

When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

Test results shall be reported in writing to the Owner, Architect, Structural Engineer, ready-mix producer, and Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, concrete type and class, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Owner. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect

Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 to 48 hours of finishing

a. Calculate the actual overall F numbers using the inferior/superior method.

b. Take measurements for elevated slabs before removal of any shores and formwork.

c. Provide the Architect and Contractor with the results of all profile tests, including a running tabulation of the overall F numbers to date, within 72 hours after the completion of each slab placement

3.21 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 033610 - BONDED POST-TENSIONED CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Provisions of the Contract Documents, including General and Supplementary Conditions, apply to the work specified in this Section.

B. This Section includes all labor, material, equipment and related services necessary to furnish, install, stress and grout all post-tensioning indicated on the drawings or specified herein, including, but not limited to the following:

1. Furnishing all post-tensioning materials, including prestressing steel, anchorages (bearing plates, grout caps, anchor heads, strand and duct couplers, wedges, spirals), duct, grout tubes, support bars, bar chairs, grouting materials and all accessories.
2. Performing all post-tensioning operations, including placement, stressing, grouting of tendons, and finishing of stressing recesses.

C. Related Work specified elsewhere:

1. Cast-In-Place Concrete: Section 033000
2. Div. 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(d) (9),16a-38k-4(b)4,16a-38k-4(b)5:
   1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 QUALIFICATIONS

A. All post-tensioned concrete work shall be under the immediate control of a person experienced in this type of work. He shall exercise close check and rigid control of all operations as necessary for full compliance with the Contract Documents.

B. The post-tensioning work shall involve a Post-Tensioning Specialty Contractor (P-T Organization) which specializes in post-tensioning and has successfully performed five previous building projects with bonded tendons that are similar to the one involved in this Contract. This P-T Organization shall supply its own post-tensioning system and shall have performed work under the same business name for the past five years. The P-T Organization shall employ a Superintendent who has a minimum of five years experience and technical knowledge of the type of post-tensioning system supplied and who shall oversee all field handling, placement, stressing, and grouting operations. The superintendent's resume shall be submitted to the Engineer of Record (Engineer) and approved prior to bid. The Superintendent and/or supervisor of the grouting operation must be a certified American Segmental Bridge Institute (ASBI) grouting technician.

C. The P-T Organization shall have a minimum Errors and Omissions Insurance coverage of $1,000,000.00.

D. The post-tensioning system shall be a bonded/grouted system that conforms to all material requirements of ACI 318. The system shall be fully encapsulated – no part or length of strand may be exposed to concrete at any point. The P-T Organization shall have a qualified registered professional engineer, licensed in the state in which the project is located, oversee the production of shop drawings and associated calculations, and certify that the post-tensioning system conforms in all aspects to the requirements of ACI 318. The professional engineer shall be a full-time employee of the P-T Organization.

E. Any P-T Organization intending to bid post-tensioning work shall submit the following to the Engineer for approval not less than 30 calendar days prior to bid date.

1. List of projects described in 1.2.B above, with the following information:
   - Consulting structural engineer, with name, address, and phone number of the individual in the company who was responsible for the project.
   - Contractor, with name, address and phone number of the Project Manager who was responsible for the project.
   - Value of post-tensioning subcontract.
   - Quantity of post-tensioning strand used on the project.

2. Resume of Professional Engineer referenced in 1.2.D. and Superintendent referenced in 1.2.B.

3. Details of anchorages as described in Section 2.4.

4. Sample of slab and beam ducts (12 inch minimum length).

5. Grout mix and properties (Re: 3.6.).

6. QA/QC plan for the supply and installation of the post-tensioning system. The QA/QC plan shall include manufacturing, assembling, plant and job site storage, handling, installation inspection, stressing, grouting and finishing.

F. Prior to the bid, written approval must be received from the Engineer in order for P-T Organizations to bid. The Engineer shall grant approval based on compliance with the specific criteria referenced herein. The Engineer's decision is final. Proposals from unapproved P-T Organizations will be rejected at the shop drawing approval stage and any delays due to such rejection shall be the responsibility of the Contractor.

G. P-T Contractors/Organizations should provide a payment and bid bond on the project. The payment and bond should cover the entire contract amount with agreed percentage.

1.3 SUMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and <u>NOTICE TO CONTRACTOR-SUBMITTALS.</u>

B. Shop Drawings

1. Complete shop drawings must be approved by the Engineer P.E. prior to starting the post-tensioning work. Once approved, shop drawings and data shall not be changed without prior, written approval of the Engineer. Post-tensioned concrete

construction operations shall not commence without approved shop drawings on file at the job site.

At a minimum, the shop drawings shall show:

- Overall concrete dimensions and pertinent member concrete dimensions
- Tendon profiles, support heights, chair types and sizes, method of support, quantity of support chairs and mild reinforcement
- Details as are necessary for the fabrication and accurate placement and stressing of the post-tensioning tendons
- Anchorage components and their assembly
- Requirements for local zone confinement reinforcement at anchorages
- Requirements for reinforcement around stressing pockets and closures
- Placement sequences, stressing procedures, including notes regarding jack clearances, sequencing, initial tensioning forces, gauge pressures
- Theoretical elongations
- Grouting materials and methods
- Identification of each tendon
- Openings, shafts, ramps, etc.
- Material summaries

The drawings shall be signed and sealed by the P-T Organization's Professional Engineer named in 1.2.4.

Along with friction and elongation calculations, the P-T Organization shall also provide signed and sealed design calculations of local anchorage zone reinforcing that may be required in accordance with AASHTO.

C. Loss and Local Anchorage Zone Calculations

1. The P-T Organization shall furnish to the Engineer, with the shop drawings, calculations of all losses to verify that design forces are obtainable for the number of strands detailed, and local anchorage zone calculations. The loss calculations shall clearly show the assumed friction and wobble coefficients and the basis for their use. The long-term losses, including shrinkage, creep and elastic shortening, shall be quantified by calculations. The calculations shall be signed and sealed by the P-T Organization's Professional Engineer named in 1.2.4. The P-T Organization shall assist the Engineer in general anchorage zone calculations if requested.

D. Approvals

1. The Engineer's approval shall not relieve the Contractor of his responsibility for performing the work in accordance with the Contract Documents.

1.4 INSPECTION

A. A *Special Inspector* shall be employed by the Owner for checking the placement and stressing of the post-tensioning, placement of reinforcing, grouting of the tendons, and placement and testing of concrete, and other items, as may be required by Local Codes.

B. Duties of the Special Inspector shall include:

1. Check duct integrity, anchorage positioning, tendon support locations, and size and placement of reinforcing in post-tensioned areas.

2. Check that tendon profiles are within the tolerances required (refer to section 3.3).

3. Verify that no concrete be placed in post-tensioned members until placement of tendons and conventional reinforcement steel have been inspected and approved.

4. Record elongations accurately for submittal to the Engineer. The Engineer shall approve stressing records prior to removal of stressing tails. Stressing records shall show a tendon reference mark, theoretical elongation, measured elongation, actual gauge pressure, date, signature of stressing operator, signature of project inspector witnessing the operation, and serial number of stressing ram and gauge.

5. Prior to stressing, verify that calibration charts are submitted for each set of stressing equipment used on the project to the Engineer. The calibration chart shall show the calibration curve for the combination of stressing jack and gauge used.

6. Observe grouting procedures and record that each duct is completely grouted. Inspect quality and testing of grout outlined in Section 3.6 .

2 PRODUCTS

2.1 The following post-tensioning materials and design procedures specifications apply and are considered to be a part of this section.

- ASTM A 416
- ACI 318
- AASHTO - “Standard Specifications for Highway Bridges” (latest edition)
- Post-Tensioning Institute “Specification for Grouting of Post-Tensioned Structures”

2.2 Prestressing Steel

A. Prestressing steel shall be ½" diameter (As = .153 sq. in), seven-wire, low-relaxation strand for prestressed concrete manufactured in accordance with ASTM A416, Grade 270, and shall have a minimum ultimate tensile strength of 41,300 pounds.

B. Certified mill test reports on the prestressing steel shall be submitted to the Engineer upon request and shall show the heat number and identification, ultimate tensile strength, yield strength at 1% extension under load, elongation at failure, modulus of elasticity, diameter and net area of strand,

and type of material. These values shall conform to the latest revisions of ASTM A416.

2.3 Anchorages

A. The post-tensioning system anchorages shall be specifically suited for bonded tendons. The anchorages shall consist of a cast-in bearing plate and a separate anchor head that is placed after concrete placement; “slap-on” anchorages shall not be permitted. All post-tensioning system anchorages must be approved in writing as per Section 1.2. Grout tubes shall not project out of the top or bottom of the slab. Anchorages shall include details that completely encapsulate the post-tensioning steel, all connections shall be mechanical and not friction-type connections.

B. The load from the anchoring device shall be uniformly distributed to the concrete by approved devices. Such approved devices shall conform to the following requirements:

1. The final unit compressive stress on the concrete directly underneath the plate or assembly shall not exceed 3,000 pounds per square inch.

2. Bending stresses in the plates or assemblies induced by the pull of the prestressing steel shall not cause visible distortion in the bearing plate when the ultimate strand load is applied as determined by testing.

3. Alternately, anchorages may be designed as special anchorage devices that use confinement reinforcement. Such special anchorage devices shall be subject to all testing requirements in AASHTO.

C. Information to be submitted for approval:

1. Complete description of the post-tensioning system anchorage and method proposed for use; such descriptions shall include tendon size, blockout dimensions, tendon layout and design calculations as required to fully substantiate any deviations from the method shown on the Contract Plans.

2. Certified Test Reports confirming the post-tensioning system anchorage meets or exceeds the minimum test requirements of AASHTO.

3. All post-tensioning system stressing anchorages shall be capable of lift-off, detensioning or retensioning a tendon at any time prior to removing the strand tails

D. Couplers

1. Coupling of bonded tendons shall be used only at locations specifically indicated and/or accepted by the Engineer.

2. Coupling of tendons shall not be used at points of sharp tendon curvature.

3. Tendon couplers shall be an integral part of the post-tensioning system and designed as such and they shall be subjected to similar requirements as the post-tensioning system anchorage.

4. Grout connections at couplers shall not project out of the top or bottom of the slab.

5. Lapping tendons at joints shall not be permitted as an effective tendon splice.

2.4 Tendons Ducts:

A. Duct shall be PT-Plus by VCL or preapproved equivalent.

B. Alternate plastic duct systems may be approved if documentation of test results indicating compliance (a letter of certification is not sufficient) with the following performance requirements is submitted to the Engineer at least 10 days prior to bid date:

1. Plastic duct shall be made of High Density Polyethylene (HDPE) according to ASTM D3350 cell classification 324420C, or Polypropylene with a specific gravity of 0.90 to 0.91.

2. Corrugation of ducts may be either spiral, concentric, or any other shape for which it has been demonstrated that the duct can be completely filled with grout.

3. Duct shall be mortar-tight and capable of transferring satisfactory bond stress. Duct shall be designed specifically for post-tensioning tendons.

4. The inside cross-sectional slab duct area shall be a minimum of five times the nominal area of the strands. Beam duct area shall conform to ACI-318 requirements.

5. The wall thickness of the duct shall be such that wearing through the wall by the strand during stressing is prevented. This requirement shall be met at specified minimum radius of curvature of the particular tendon size with a total strand movement of 3 feet and the full tendon stressed to 80% GUTS. The minimum remaining wall thickness of the duct after testing shall be at least 0.04 inches.

6. If couplers are required, ducts shall be coupled with specially designed couplers in a manner that is watertight without the use of tape.

7. Ducts with couplers shall be able to transfer longitudinal forces as follows without effecting watertightness : for duct diameter up to 2-1/2 inches, 200 pounds, and for duct diameter exceeding 2-1/2 inches, 400 pounds.

8. Ducts with couplers shall be capable of bending to a specified minimum radius of curvature without causing damage or sharp kinks in the duct. This requirement is met if at least three full cycles of reversed bending have been applied to the duct and watertightness is not affected (Re: 2.4.2.9). A minimum radius of curvature of 3 feet shall apply for ducts in prefabricated tendon applications.

9. Ducts including couplers shall be watertight. Watertightness is provided if water loss in 40 inch long duct specimens with couplers, tested according to 2.4.2.7 and 2.4.2.8, do not exceed 1.5% of the duct volume within 5 minutes. Water shall be kept at a pressure of 7 psi during the test.

10. Irreversible deformations of the duct cross-sectional dimensions, i.e. diameter, under a point load of 150 pounds shall not exceed 1/4 inch nor 5% of the duct cross-sectional dimensions, whichever is larger, one minute after removal of the load at 70ºF ambient temperature. The point load shall be applied without impact through a #4 reinforcement bar, bearing on the duct between corrugations.

11. Friction and wobble coefficients for the particular duct shall be submitted by the P-T Organization to the Engineer Frictional losses due to vertical and horizontal intentional or non-intentional variance from a straight line trajectory shall be based on experimentally determined curvature and wobble coefficients, and experience from previous jobs.

2.5 Grout

Refer to Section 3.6.

3 EXECUTION

3.1 Scheduling

A preconstruction conference shall be held. Attendees shall include the Engineer, Contractor's representative, and the P-T Organization's Professional Engineer and Superintendent. At this time, the post-tensioning operations shall be coordinated with the General Construction schedule. The Engineer shall approve all tensioning locations, construction joints, and the acceptability of the general plan of the field post-tensioning operations.

3.2 Fabrication

A. Post-tensioning tendons shall be manufactured in accordance with detailed shop drawings approved by the Engineer.

B. Post-tensioning tendons shall be of the non-fixed length type to allow for possible form adjustments in the field.

C. Tendon fabrication and delivery should be coordinated by General Contractor so as to prevent lengthy job site storage. All prestressing steel shall be satisfactorily protected from excessive rust or other corrosion prior to placement. Sufficient protection shall also be provided for exposed prestressing steel at the ends of members to prevent deterioration by corrosion.

3.3 Placing

A. All placement shall be under the immediate control of the P-T Organization's Superintendent. He shall exercise close check and rigid control of all operations as necessary for full compliance with all requirements.

B. Placement of mild steel reinforcement shall be coordinated with placement of post-tensioning tendons. Proper tendon location takes precedence.

C. Tendons shall clear openings and drains by a minimum of 3 inches.

D. Slight deviation in horizontal spacing of the slab tendons is permitted where required to avoid openings and inserts, as detailed on the placement drawings.

E. Post-tensioning tendons shall have parabolic profiles (unless otherwise required by the design) and shall conform to the control points shown on the drawings. Support heights locating these profiles shall account for the center of gravity of the strands within the ducts. Low points of the tendons are at mid-span and high point corresponds to the center line of support, unless otherwise noted.

F. Suitable horizontal and vertical supports or chairs shall be installed as shown on the shop drawings to hold the tendons in true position. Tendons shall be tied to supports or chairs at maximum spacings as recommended by the

Post-Tensioning Institute. All strands in a given pour shall be full length without splices or couplers unless called for on the approved shop drawings.

G. Post-tensioning tendons and anchorages shall be placed with a vertical tolerance of 1/4 inch in concrete dimensions less than 8 inches, 3/8 inch in concrete dimensions of 8 inches to 24 inches, and 1/2 inch in concrete dimensions of greater than 24 inches.

H. All post-tensioning tendons shall have a grout vent at all anchorages. Grout vents shall not project out of the top of the slab.

I. Post-tensioning anchorages shall be installed perpendicular to the tendon axis and have the minimum required tangent length.

J. Duct materials shall be inspected prior to concrete placement. Damaged duct shall be repaired in accordance with procedures acceptable to the engineer of record.

K. Where the end of a post-tensioning tendon will not be covered by concrete, the anchorages shall be recessed so that the ends of the prestressing steel will be at least 1-1/2 inch inside the edge of the concrete.

L. Tendons shall not be subjected to excessive temperatures, welding sparks or electric ground currents. To insure that this requirement is met, burning and welding operations shall not be conducted in the vicinity of tendons without prior approval. Stressing tails may be removed by rapid oxyacetylene burning or friction blade cutting to within 1” of the face of the anchorhead.

M. Pre-placing of strands in flat duct is mandatory prior to concrete placement. Pre-placing of strands in round duct is recommended prior to concrete placement. Placing of strand in round duct after concreting is satisfactory provided that measures are taken to prevent movement or floatation of the duct during concreting.

3.4 Concrete Placement

A. Concrete shall be placed in conformance with the requirements as outlined in Division 3, Cast-In-Place Concrete.

B. Calcium Chloride shall not be used as an admixture in post-tensioned concrete.

C. No concrete shall be placed in a particular pour until the tendons and reinforcement have been inspected and approved by the Special Inspector or the Engineer or his designated representative. The approval of the engineer of record shall not relieve the Contractor from his obligation for proper placement, and stressing of tendons, or other terms of this contract.

D. Concrete shall be placed in such a manner as to insure that the position of the post-tensioning tendons and conventional reinforcement remains unchanged. If the post-tensioning tendons move out of their designed positions, they

shall be adjusted to their correct positions prior to proceeding with concrete placing operations.

E. Special provisions shall be made to insure proper consolidation of concrete in anchorage zones to prevent any voids or honeycombing.

3.5 Stressing

A. All post-tensioning shall be under the immediate control of the P-T Organization's Superintendent. He shall exercise close check and rigid control of all operations as necessary for full compliance with all requirements.

B. Before post-tensioning operations begin, all equipment shall be carefully inspected and tested by the P-T Organization. Tests shall include calibration of gauges, capacity of jacks and rams, and general condition and working order of equipment.

C. The stressing operations shall not begin until tests of the concrete cylinders, cured under jobsite conditions, verify the minimum compressive strength specified on the Contract Drawings. However, if specified on the Contract Drawings, an early partial prestress force may be applied at a concrete compressive strength less than the minimum compressive strength to help minimize plastic shrinkage cracking. The partial prestress force shall be proportionately lower than the full prestress force according to the actual concrete strength at the time the partial prestress force is applied. The full prestress shall be applied when the concrete strength reaches the minimum compressive strength specified.

D. It is intended that the stressing operation begin at the earliest possible time so as to minimize the occurrence of shrinkage and temperature cracking. To this end, it is anticipated that measures be taken (such as low water/cement ratio concrete and proper curing) in order that the early strength gain is achieved within three days, but no longer than five days, from date of concrete placement.

E. Strength of concrete members will be determined by testing standard ASTM 6" diameter test cylinders for each representative pour of 100 cu. yds, or fraction thereof, a minimum of six field-cured, and two lab-cured specimens shall be made. Lab-cured cylinders will be tested at 28 days. Field-cured cylinders shall be maintained at the site and cured under conditions identical to the in-place concrete sections represented by them. They shall be tested in sets of two, at the Contractor's discretion. Such tests shall be the basis for determining when stressing operations may commence. When field-cured cylinders have attained the designated compressive strength, stressing operations may commence. Falsework removal and reshoring may commence when stressing operations are complete and prior to injection grouting of the tendons.

F. The post-tensioning tendons shall be stressed by means of hydraulic jacks equipped with calibrated hydraulic pressure gauges to permit the stress in the

prestressing steel to be computed at any time. A calibration chart shall accompany each jack-pump-gauge unit. In no case shall a jack and gauge combination be used which have not been calibrated to each other. In order to insure that proper calibration is maintained, care shall be exercised in the handling of all stressing equipment.

G. The stressing operations shall be conducted so that accurate elongation of the prestressing steel can be measured and recorded to the nearest 1/8 inch and compared with predicted elongations. An agreement within ± 7% between measured and predicted elongations shall be satisfactory. If inconsistencies exceeding ± 7% occur, the Engineer, with the assistance of the P-T Organization, shall review and determine whether any additional action is required.

H. Stressing from both ends of the prestressing steel shall be performed when there is excessive friction between the prestressing steel and the duct, depending upon the location of construction joints and construction sequencing. Stressing locations for each tendon shall be shown on the approved shop drawings.

I. The maximum temporary tensile stress (jacking stress) in the prestressing steel shall not exceed 80% of the specified guaranteed minimum ultimate tensile strength of the prestressing steel. The prestressing steel shall be anchored at stresses (initial stress) that will result in the ultimate retention of working forces of not less than those shown on the Contract Drawings

J. Records shall be kept by the Special Inspector of the elongation and force applied to each strand and this shall be submitted to the Engineer promptly upon completion of stressing of each pour.

K. Safety precautions shall be taken to prevent workers from standing over or behind the stressing jacks when tendons are being stressed. Only essential personnel shall be permitted in the area during stressing.

3.6 Grouting

A. The P-T Organization shall own and furnish all specialized equipment necessary to grout the tendons.

B. Grouting records certifying the proper grouting of each duct shall be submitted within 72 hours after grouting by the Special Inspector to the Engineer for review. Information shall include: grout materials and proportions, worker's names, date and time, ambient temperature, weather conditions, and concrete temperature, maximum pumping pressure at inlet. Additional information such as possible blockages, leaks in the system, or interruptions in the flow of grout, and procedures taken to correct the deficiency, shall be reported.

C. A trial grout mix shall be batched in advance of grouting operations to verify the grout properties and the compatibility of the cement, water and admixtures.

D. Four types of grout are available for grouting. Class A grout is used for non-aggressive exposure and exhibits no thixotropic properties. Class B grout is used for aggressive exposures and may exhibit thixotropic properties. Class C grout is prepackaged grout and may exhibit thixotropic properties. Class D grout is specially designed grouts for specific applications.

E. Materials and Equipment:

1. Portland cement shall conform to the following:
   a) Specifications for portland cement ASTM C150 Type I, II, or I/II.
   b) Cement used for grouting shall be fresh and not contain any lumps or other indications of hydration or "pack set".

2. Water:
   a) The water used in the grout shall be potable, clean and free of injurious quantities of substances known to be harmful to or incompatible with the Portland cement, prestressing steel, or admixtures.

3. Admixtures:
   a) Admixtures shall impart the properties of low water content, good flowability, adequate open time, minimum bleed, minimum permeability and adequate compressive strength to the grout. Admixtures shall contain no substances known to be harmful to or incompatible with the Portland cement or prestressing steel. Admixtures containing chlorides, fluorides, sulfites, and nitrates shall not be used.

4. Grouting Equipment:
   a) The grouting equipment shall include a colloidal type mechanical mixer capable of continuous mixing which will produce a grout free of lumps and undispersed cement. The holding tank shall contain an agitator for the purpose of keeping the grout in continuous motion until injected into the tendon. When using thixotropic grout, the equipment shall consist of two identical charging/holding tanks.
   b) The pumping device shall be a positive displacement type capable of producing an outlet pressure at the pump of at least 145 psi.
   c) The grouting equipment shall have seals adequate to prevent the introduction of air, oil or other foreign substances into the grout.
   d) Accessory equipment which will provide for accurate solid and liquid measures of all grout components shall be provided to batch all materials.

e) The grouting equipment shall contain a screen having clear openings of 1/8 inch maximum size to filter the grout prior to its introduction into the holding tank or immediately prior to Being injected into the tendon. A maximum screen opening of 3/16 inch can be used for thixotropic grouts. The screen shall be easily accessible for inspection and cleaning.

f) The holding tank and/or mixing tank must be kept partially full of grout at all times during the pumping operation to prevent air from being drawn or siphoned into the grout hose or duct.

F. Grout Property Requirements:

1. The maximum water-cement ratio shall be 0.45.

2. The grout must remain pumpable for a minimum of 30 minutes. The initial flow cone efflux time of a non-thixotropic grout shall be a minimum of 11 seconds and a maximum of 30 seconds immediately after mixing. Refer to ASTM C939, Standard Test Method For Flow Of Grout. For thixotropic grouts, the efflux time shall have a minimum of 9 seconds and a maximum of 20 seconds for a 1-liter discharge. Use a modified version of ASTM C939 by filling the flow cone to the top instead of the standard level.

3. All classes of grout shall exhibit no measurable bleed after 3 hours when using a wick induced bleed test at 20°C (70°F). Refer to ASTM C940, Standard Test Method For Expansion And Bleeding Of Freshly Mixed Grouts. Class B and C grouts shall have a maximum bleed of 4 percent when using the Schupack Pressure Bleed Test with 20 psi and a vertical rise of 0 to 2 feet.

4. The minimum compressive strength of the grout at 7 days shall be 3,000 psi. The minimum compressive strength of the grout at 28 days shall be 5,000 psi. Refer to ASTM C942, Standard Test Method For Compressive Strength Of Grout.

5. The permeability of the grout shall be determined by referring to ASTM C1202, Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration. Grout at 28 days of age shall have a maximum value of 2500 Coulombs after 6 hours.

6. The volume change of grout shall be 0.0% to +0.1% at 24 hours. The volume change at 28 days shall not be greater than +0.2%. Refer to ASTM C1090, Standard Test Method for Measuring Changes in Height of Cylindrical Specimen from Hydraulic-Cement Grout.

7. The temperature of the freshly prepared grout shall not be less than 40F or greater than 100F, the optimal temperature range is 50F-70F.

8. The setting time of the grout shall be greater than 3 hours and less than 12 hours. Refer to ASTM C953, Standard Test Method for Time of Setting of Grouts for Preplaced Aggregate Concrete in the Laboratory.

G. Mixing and Injection of the Grout:

1. It is generally desirable that tendons be grouted as soon as practical after approval of the stressing operations.

2. After a period of freezing weather conditions, grouting may be carried out only when it is certain that no ice will be trapped in the ducts.

3. Grouting may proceed when the surrounding concrete temperature is a minimum of 35F and rising. The grout temperature shall be maintained between 40F-90F before entering the duct. Grout temperature must be maintained at a minimum of 35F after entering the duct for three consecutive days after grouting or until a minimum compressive strength of 800 psi is attained as determined by job-cured 2 inch cube tests.

4. Grout fittings shall be non-metallic and not project out of the top or bottom of the slab.

5. Mixing shall be of such duration as to obtain a uniform and thoroughly blended grout, approximately 2-3 minutes.

6. Grout shall completely fill the void space within the duct under a normal pumping pressure of 75 psi. For internal flat ducts, pumping pressure shall not exceed 100 psi. For internal circular ducts, pumping pressure shall not exceed 245 psi.

7. Grout shall be injected from the lower end of the tendon in a continuous manner until it is discharged from the opposite end. The grout shall be continuously ejected from the outlet until no slugs of water or air are visible and the grout at the outlet is approximately the same viscosity as that at the inlet. Close the valve at the outlet followed by the valve at the inlet prior to relieving the pressure at the grout pump.

8. Grout injection shall be between 15ft. and 50 ft. per minute unless otherwise approved by Engineer.

9. Leaks at the grout fittings at each end of the tendon or at any intermediate locations shall not be permitted.

10. Grout fittings may be removed flush with the concrete such that there is no spalling, after the grout has set for 24 hours.

3.7 Field Testing

1. One bleed test shall be taken per day for Class B and D grouts. The test shall be taken from the mixer. The sample test shall be either a Wick Induced Bleed Test or Schupack Pressure Bleed Test.

2. Two mud balance tests shall be taken per day for all classes of grout. Mud balance tests shall be performed in addition to the two daily tests whenever an apparent change in the grout appears.

3. One strength test shall be taken during the grouting.

4. At least two flow cone tests – one at the mixer and one at the outlet, per every two hours of grouting operation for all classes of grout. The flow cone tests shall be either the ASTM C939 or the modified ASTM C939 tests.

3.8 Finishing of Stressing Recesses

1. Stressing recesses shall be properly prepared and then filled flush with a non-shrink, non-metallic, non-corrosive grout to give a satisfactory appearance per the project requirements.

END OF SECTION 033610

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Decorative concrete masonry units.
3. Precast architectural concrete trim units.
4. Mortar and grout.
5. Steel reinforcing bars.
6. Masonry joint reinforcement.
7. Ties and anchors.
8. Embedded flashing.
9. Miscellaneous masonry accessories.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credit 16a-38-4(d)11 and 16a-38-4(b)4.
   a. The above listed HPB credit is related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 051200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
3. Section 055000 "Metal Fabrications" for furnishing steel lintels and shelf angles for unit masonry.
4. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

   a. For Concrete Unit Masonry: f’m = 1900 psi

B. Delegated Design: Engage a qualified professional engineer, to design precast architectural concrete trim units.

C. Design Standards: Comply with ACI 318 (ACI 318M) and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
2. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
3. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

1.6 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and <u>NOTICE TO CONTRACTOR – SUBMITTALS.</u>

B. Product Data: For each type of product indicated.

C. Design Mixtures: For each precast architectural concrete trim unit mixture. Include compressive strength and water-absorption tests.

D. Shop Drawings: For the following:

1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
3. Precast architectural concrete trim units:
   a. Detail fabrication and installation of architectural precast concrete units.

b. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit.
c. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
d. Indicate details at building corners.

E. Samples for Initial Selection:

1. Precast architectural concrete trim units.
2. Colored mortar.
3. Weep holes/vents.

F. Samples for Verification: For each type and color of the following:

1. Decorative CMUs.
2. Color mortar. Make Samples using same sand and mortar ingredients to be used on Project.
3. Weep holes and vents.
4. Accessories embedded in masonry.
5. Precast architectural concrete trim units: Design reference samples for initial verification of design intent, for each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of three, representative of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches (300 by 300 by 50 mm).

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.
b. For masonry units, include data and calculations establishing average net-area compressive strength of units.
2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Reinforcing bars.
6. Joint reinforcement.
7. Anchors, ties, and metal accessories.
8. Precast architectural concrete trim units:
a. Include material test reports substantiating compliance with requirements for aggregates.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.8 QUALITY ASSURANCE (UNIT MASONRY)

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

E. Sample Panel: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build sample panel of wall area as shown on drawings, including face and backup wythes and accessories.

    a. Include a sealant-filled joint at least 16 inches (400 mm) long in exterior face.
    b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches (300 mm) wide by 16 inches (400 mm) high.
    c. Include through-wall flashing installed for a 24-inch (600-mm) length in corner of exterior wall mockup approximately 16 inches (400 mm) down from top of mockup, with a 12-inch (300-mm) length of flashing left exposed to view (omit masonry above half of flashing).
    d. Include air barrier, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.
2. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
3. Protect accepted mockups from the elements with weather-resistant membrane.
4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.

    a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
    b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.

5. Remove mock-ups in its entirety when directed by the architect.

F. Preinstallation Conference: Conduct conference at Project site.

1.9 QUALITY ASSURANCE (PRECAST ARCHITECTURAL CONCRETE TRIM UNITS)

A. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

1. Designated as a PCI-certified plant or designated as an APA-certified plant for production of architectural precast concrete products.
2. Fabricator is located within 500 miles (800 km) of Project site.

B. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."

1.10 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.11 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls and hold cover securely in place.

2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged and bullnose units for outside corners, where indicated.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units .

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

a. Products: Subject to compliance with requirements, provide one of the following:

1) ACM Chemistries; RainBloc.
2) BASF Aktiengesellschaft; Rheopel Plus.
3) Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.

C. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi .
2. Density Classification: Medium weight unless otherwise indicated.
3. Size : Manufactured to dimensions 3/8 inch less than nominal dimensions.
   a. Nominal Dimensions: Unless otherwise noted, provide 8 inch high x 16 inches wide x depth indicated on the drawings.

D. Decorative CMUs: ASTM C 90.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Ravenstone, Trendstone Ground Face Masonry Units; Trenwyth Industries, Inc.
2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi (14.8 MPa).
3. Density Classification: Normal weight.
4. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.
5. Pattern and Texture:

a. Standard pattern, ground-face finish.

6. Colors: As selected by Architect from manufacturer's full range.

2.3 MASONRY LINTELS

A. General: Provide one of the following:

B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 PRECAST ARCHITECTURAL CONCRETE TRIM UNITS

A. Portland Cement: ASTM C 150/C 150M, Type I or Type III, gray, unless otherwise indicated.

1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.

B. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
2. Metakaolin: ASTM C 618, Class N.
3. Silica Fume: ASTM C 1240, with optional chemical and physical requirement.
4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33/C 33M, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

1. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand compatible with coarse aggregate; to match approved finish sample.

D. Coloring Admixture: ASTM C 979/C 979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.

E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

G. Finish:
1. Acid-Etched Finish: Use acid and hot-water solution, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces. Protect hardware, connections, and insulation from acid attach.
2. Finish exposed surfaces of architectural precast concrete units to match face-surface finish.

H. Color: As selected by Architect from manufacturer’s full range.
1. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Davis Colors; True Tone Mortar Colors.
b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
c. Solomon Colors, Inc.; SGS Mortar Colors.

E. Colored Cement Product: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Portland Cement-Lime Mix:

a. Products: Subject to compliance with requirements, provide one of the following:

1) Capital Materials Corporation; Riverton Portland Cement Lime Custom Color.
2) Lafarge North America Inc.; Eaglebond Portland & Lime.
3) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.

2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
3. Pigments shall not exceed 10 percent of portland cement by weight.

F. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

G. Aggregate for Grout: ASTM C 404.

H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent by same manufacturer.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ACM Chemistries; RainBloc for Mortar.
b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.
c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.

I. Water: Potable.

2.6 REINFORCEMENT (UNIT MASONRY)

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Mill- galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Exterior and Interior Walls in Rooms S102, S103, S104, S105, S106, S107, S108, S108A, S109, S110, S111, S112, S114, Stair R: Stainless steel.
4. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
5. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
6. Wire Size for Veneer Ties: 0.148-inch (3.77-mm) diameter.
7. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (407 mm) o.c.
8. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

D. Masonry Joint Reinforcement for Multiwythe Masonry:

1. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches (32 mm). Size ties to extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.

E. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized, carbon-steel continuous wire.

2.7 REINFORCING MATERIALS (PRECAST ARCHITECTURAL CONCRETE TRIM UNITS)

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from as-drawn steel wire into flat sheets.

D. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

E. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.8 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 641/A 641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches (50 mm) parallel to face of veneer.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.

1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches (50 mm) long may be used for masonry constructed from solid units.
2. Where wythes do not align or are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches (32 mm).
3. Wire: Fabricate from 3/16-inch- (4.76-mm-), hot-dip galvanized steel wire. Mill-galvanized wire ties may be used in interior walls unless otherwise indicated.

D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, hot-dip galvanized steel-wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

E. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:

   a. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play in excess of 0.05 inch (1.3 mm).

2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.075-inch- (1.90-mm-) thick steel sheet, galvanized after fabrication.
3. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.187-inch-(4.76-mm-)diameter, hot-dip galvanized-steel wire unless otherwise indicated.
4. Contractor's Option: Unless otherwise indicated, provide any of the following types of anchors:

5. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.

   a. Products: Subject to compliance with requirements, provide one of the following:

      1) Dayton Superior Corporation, Dur-O-Wal Division; D/A 213.
      2) Wire-Bond; RJ-711.

   b. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches (70 mm) wide by 3 inches (76 mm) high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section.

6. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 (4.83-mm) diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.

7. Stainless-Steel Drill Screws for Steel Studs: Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with ASTM C 954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 (4.83-mm) diameter by length required to penetrate steel stud flange with not less than three exposed threads.

2.9 MISCELLANEOUS ANCHORS

A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.

B. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

C. Post-installed Anchors: Torque-controlled expansion anchors or chemical anchors.

   1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
   2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 unless otherwise indicated.
   3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.10 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch (0.40 mm) thick.
2. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide matching splice plates at joints
3. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.

B. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Copper-Laminated Flashing: 5-oz./sq. ft. (1.5-kg/sq. m) copper sheet bonded between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

   a. Products: Subject to compliance with requirements, provide one of the following:
      1) Dayton Superior Corporation, Dur-O-Wal Division; Copper Fabric Thru-Wall Flashing.
      2) Hohmann & Barnard, Inc.; H & B C-Fab Flashing.
      3) York Manufacturing, Inc.; Multi-Flash 500.

2. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch (1.02 mm).

   a. Products: Subject to compliance with requirements, provide one of the following:
      1) Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
      2) Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
      3) Hohmann & Barnard, Inc.; Textroflash.

   b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use flexible flashing with stainless steel metal drip edge.
4. Where flashing is fully concealed, use flexible flashing.

D. Solder and Sealants for Sheet Metal Flashings

1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
2. Elastomeric Sealant: ASTM C 920, as specified in Division 7 Section “Joint Sealants.

E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.11 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene or urethane.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Use one of the following unless otherwise indicated:
   1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.

      a. Products: Subject to compliance with requirements, provide one of the following:
         1) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
         2) Heckmann Building Products Inc.; No. 85 Cell Vent.
         3) Hohmann & Barnard, Inc.; Quadro-Vent.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

   1. Products: Subject to compliance with requirements, provide one of the following:

      a. Advanced Building Products Inc.; Mortar Break.
      b. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
      c. Mortar Net USA, Ltd.; Mortar Net.

   2. Provide one of the following configurations:

      a. Strips, full-depth of cavity and 10 inches (250 mm) high, with dovetail shaped notches 7 inches (175 mm) deep that prevent clogging with mortar droppings.

F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

   1. Products: Subject to compliance with requirements, provide one of the following:

      a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.

b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.

2.12 CAVITY-WALL INSULATION

A. Refer to Division 07 Section “Thermal Insulation”.

2.13 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Diedrich Technologies, Inc.
b. EaCo Chem, Inc.
c. ProSoCo, Inc.

2.14 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced and loadbearing masonry, use Type S.
3. For exterior, above-grade, non-load-bearing walls and parapet walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Mix to match Architect's sample.

3. Application: Use pigmented mortar for exposed mortar joints with the following units:

a. Decorative CMUs.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Application: Use colored aggregate mortar for exposed mortar joints with the following units:

a. Decorative CMUs.

F. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1orparagraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2500 psi.
3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured according to ASTM C 143/C 143M.

2.15 FABRICATION (PRECAST ARCHITECTURAL CONCRETE TRIM UNITS)

A. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.

B. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.

C. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.

D. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses and specified in-place loads.

E. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

F. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch (25 mm) or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.

G. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.

H. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.

1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.

I. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.

J. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

K. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

2.16 FABRICATION TOLERANCES (PRECAST ARCHITECTURAL CONCRETE TRIM UNITS)

A. Fabricate architectural precast concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).

3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches (100-mm). Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c. unless otherwise indicated.
3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 "Fire-Resistive Joint Systems."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
5. Unless otherwise indicated, provide 3/8 inch high joints.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive direct-applied finishes (other than paint) unless otherwise indicated.

3.6 CAVITY WALLS

A. Bond wythes of cavity walls together using the following method:

1. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
   a. Use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

3.7 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

1. Space reinforcement not more than 16 inches (406 mm) o.c.
2. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity atreturns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.8 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1 inch (25 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.9 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
3. Embed tie sections in masonry joints. Provide not less than 2 inches (50 mm) of air space between back of masonry veneer and face of sheathing.
4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
5. Space anchors as indicated, but not more than 16 inches (406 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally with not less than 1 anchor for each 2.67 sq. ft. (0.25 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 36 inches (914 mm), around perimeter.

3.10 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Install preformed control-joint gaskets designed to fit standard sash block.

3.11 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.12 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 4 inches (100 mm), and 1-1/2 inches (38 mm) into the inner wythe..
3. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches (200 mm); with upper edge tucked under building paper or building wrap, lapping at least 4 inches (100 mm).
4. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products to form weep holes.
2. Space weep holes 32 inches o.c. unless otherwise indicated.

E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

F. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.

3.13 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

3.14 PRECAST ARCHITECTURAL CONCRETE TRIM UNIT INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

B. Set architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.

1. Maintain horizontal and vertical uniform joint width as erection progresses.
2. Unless otherwise indicated, maintain uniform joint widths of 3/8 inch.

C. Connect architectural precast concrete units in position by grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

D. Grouting or Dry-Packing Connections and Joints: Grout connections where required or indicated. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for not less than 24 hours after initial set.

E. Erect architectural precast concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

3.15 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Level 2 special inspections according to the "2005 Connecticut Supplement with 2009 Amendment – State Building Code."

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency for Vertically Reinforced Masonry: One set of tests for each 1500 sq. ft. (140 sq. m) of wall area or portion thereof, with a minimum of one test per day.

E. Testing Frequency for Non-loadbearing Masonry: One set of tests for each 5000 sq. ft. (460 sq. m) of wall area or portion thereof.

F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

G. Mortar Test (Compressive Strength): For each mix provided, according to ASTM C 780.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.16 REPAIRING, POINTING, AND CLEANING (UNIT MASONRY)

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.17 REPAIRS (PRECAST ARCHITECTURAL CONCRETE TRIM UNITS)

A. Repair architectural precast concrete units if permitted by Architect. Architect reserves the right to reject repaired units that do not comply with requirements.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet (6 m).

C. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.18 CLEANING (PRECAST ARCHITECTURAL CONCRETE TRIM UNITS)

A. Clean surfaces of precast concrete units exposed to view.

B. Clean mortar and other deleterious material from concrete surfaces and adjacent materials immediately.

C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

3.19 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Refer to Section 017419 “Construction Waste Management and Disposal”.

B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Grout.

B. Related Sections:
   1. Section 03 3000 “Cast In Place Concrete” For concrete structure supporting structural steel and composite slab and composite structural steel members.
   2. Section 04 2000 “Unit Masonry” for masonry bearing wall supporting structure steel beam and metal deck.
   3. Section 05 31 00 "Steel Decking" for field installation of shear connectors through deck.
   4. Section 05 50 00 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other metal items not defined as structural steel.
   5. Section 05 51 00 "Metal Stairs."
   6. Section 09 91 23 "Interior Painting" for surface-preparation and priming requirements.
   7. Div. 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4,16a-38k-4(b)5,16a-38k-4(d)9,16a-38k-4(d)11:
      1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

B. Engineering Responsibility: Engage a fabricator who utilizes a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for structural steel connections.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.2-1.05.02 and NOTICE TO CONTRACTOR-SUMITTALS.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Show fabrication of structural-steel components.
   1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   2. Indicate welds by standard AWS symbols.

      a. Distinguish between shop and field welds, and show size, length, and type of each weld.
   3. For structural-steel connections indicated to comply with design loads, include structural analysis data on Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For firms and persons to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Mill test reports for structural steel, including chemical and physical properties, signed by manufacturer certifying that their products comply with requirements.

C. Product Test Reports: For the following:
   1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
   2. Direct-tension indicators.
   3. Shear stud connectors.
   4. Shop primers.
   5. Nonshrink grout.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Engage a qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, experienced in fabricating structural steel similar to that indicated for this Project, and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.
   1. Fabricator shall be registered with and approved by authorities having jurisdiction.

B. Installer Qualifications: Engage a qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE, experienced in completing structural steel work similar in material, design, and extent to that indicated for this Project, and with a record of successful in-service performance.

C. Comply with applicable provisions of the following specifications and documents:
   1. AISC's "Steel Construction Manual - American Institute of Steel Construction, Inc - Thirteenth Edition."
   2. AISC's "Seismic Provisions for Structural Steel Buildings."
   3. ASTM A 6 (ASTM A 6M) "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."

4. Research Council on Structural Connections' (RCSC) "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
5. Research Council on Structural Connections' (RCSC) "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Professional Engineer Qualifications: A professional engineer that has a record of successful in-service performance, who is legally authorized to practice in the jurisdiction where Project is located, and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification..

F. Preinstallation Conference: The contractor shall Conduct conference at Project site to coordinate with all parties of concern.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

C. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
1. Clean and relubricate bolts and nuts that become dry or rusty before use.
2. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.8 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. Structural Steel Angles, Channels, Rods, Plates, and Bars: ASTM A 36/A 36M.

B. Structural Steel Wide Flange Shapes and Tees: ASTM A 992/A 992M.

C. Cold-Formed Structural Steel Tubing: ASTM A 500, Grade B.

D. Hot-Formed Structural Steel Tubing: ASTM A 501, seamless or welded.

E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
   1. Weight Class: As indicated on Drawings.
   2. Finish: Black except where indicated to be galvanized.

F. Carbon Steel Castings: ASTM A 27, Grade 65-35 (ASTM A 27M, Grade 450-240), medium-strength carbon steel.

G. High-Strength Steel Castings: ASTM A 148, Grade 80-50 (ASTM A 148M, Grade 550-3345).

H. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. Non-High-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A carbon-steel, hex-head bolts; carbon-steel nuts; and flat, unhardened steel washers.
   1. Finish: Hot-dip zinc-coating, ASTM A 153, Class C.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers.
   1. Finish: Hot-dip zinc-coating, ASTM A 153, Class C.
   2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

C. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers, uncoated.
   1. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type with plain finish.

D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

E. Anchor Rods, Bolts, Nuts, and Washers: As follows:
   1. Unheaded Rods: ASTM A 36/A 36M.
   2. Unheaded Rods: ASTM A 572/A 572M, Grade 50 (345).
   3. Unheaded Bolts: ASTM A 687, high strength.

4. Headed Bolts: ASTM A 307, Grade A (ASTM F 568, Property Class 4.6); carbon steel, hex-head bolts; and carbon steel nuts.
5. Headed Bolts: ASTM A 325/A 325M, Type 1, heavy hex steel structural bolts and heavy hex carbon steel nuts.
6. Headed Bolts: ASTM A 490/A 490M, Type 1, heavy hex steel structural bolts and heavy hex carbon steel nuts.
7. Washers: ASTM A 36/A 36M.

2.3 PRIMER

A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
   1. Provide a dry film thickness of no less than 1.5 mils.

B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds and repair painting galvanized steel, with dry film containing not less than 93 percent zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.
   1. Provide a minimum 1.7 oz./sq. ft. galvanized coating.

2.4 GROUT

A. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404, Size No. 2. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 PREFABRICATED BUILDING COLUMNS

A. General: Prefabricated building columns consisting of load-bearing structural-steel members encased in manufacturer’s standard insulating material for fire protection and enclosed in an outer, non-load-bearing steel shell. The load-bearing pipe and tune column will be filled with concrete.
   1. Concrete Fill: Manufacturer’s standard-mix structural concrete, with a minimum 28-day compressive strength of 5000 psi (34.5 MPa), machine mixed and mechanically vibrated during placement to produce concrete fill free of voids

B. Fire-Resistance Rating: Provide prefabricated building column listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for ratings indicated, based on testing according to ASTM E 110.
   1. UL Fire-Resistance Rating Design Number: X106 (2-Hour), X104 (3-Hour), or X101 (4-Hour) as specified/indicated.

C. Column Configuration: Provide columns of sizes and shapes indicated. Fabricate connections to comply with details shown or as required to suite type of structure indicated.

D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering prefabricated building columns that may be incorporated into the work.

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.
   1. Camber structural-steel members where indicated.
   2. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
   3. Mark and match-mark materials for field assembly.
   4. Fabricate for delivery a sequence that will expedite and minimize field handling of structural steel.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
   6. Comply with fabrication tolerance limits of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for structural steel.

B. Fabricate architecturally exposed structural steel with exposed surfaces smooth, square, and free of surface blemishes, including pitting, rust and scale seam marks, roller marks, rolled trade names, and roughness.
   1. Remove blemishes by filling, grinding, or by welding and grinding, prior to cleaning, treating, and shop priming.
   2. Comply with fabrication requirements, including tolerance limits, of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for architecturally exposed structural steel

C. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

D. Bolt Holes: Drill or punch standard bolt holes perpendicular to metal surfaces.

E. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Welded Door Frames: Build up welded door frames attached to structural steel. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated.

H. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
   1. Drill or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.

2. Baseplate Holes: Drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

A. Non-High-Strength Bolts: Shop install and tighten non-high-strength bolts, except where high-strength bolts are indicated.

B. High-Strength Bolts: Shop install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. High-Strength Bolts: Shop install and tighten high-strength bolts according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
1. Bolts: ASTM A 325/A 325M high-strength bolts, unless otherwise indicated.
2. Bolts: ASTM A 490/A 490M high-strength bolts, unless otherwise indicated.
3. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.
4. Connection Type: Slip-critical, direct-tension, or tensioned shear/bearing connections as indicated.

D. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.8 SHOP PRIMING

A. Shop prime steel surfaces except the following:
1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 5, “White Metal Blast Cleaning.”
4. SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
5. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness

of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel indicated for galvanizing according to ASTM A 123/A 123M.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
   1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.
   2. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in or remove and replace structural steel that test reports and inspections indicate do not comply with specified requirements.

C. Additional testing, at Contractor’s expense, will be performed to determine compliance of corrected Work with specified requirements.

D. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Load and resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

F. Direct-tension indicator gaps will be verified to comply with ASTM F 959, Table 2.

G. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M. Test all full penetration welds using the following inspection procedures, at testing agency's option:
   1. Liquid Penetrant Inspection: ASTM E 165.
   2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
   3. Ultrasonic Inspection: ASTM E 164.
   4. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level “2-2T.”.

H. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
   1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
   1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
   1. Maintain erection tolerances of architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.
   2. Establish required leveling and plumbing measurements on mean operating temperature of structure.
   3. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

G. Do not use thermal cutting during erection.

H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. Non-High-Strength Bolts: Install and tighten non-high-strength bolts, except where high-strength bolts are indicated.

B. High-Strength Bolts: Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

C. High-Strength Bolts: Install and tighten high-strength bolts according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
   1. Bolts: ASTM A 325/A 325M high-strength bolts, unless otherwise indicated.
   2. Bolts: ASTM A 490/A 490M high-strength bolts, unless otherwise indicated.
   3. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.
   4. Connection Type: Slip-critical, direct-tension, or tensioned shear/bearing connections as indicated.

D. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.
   3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent surface bleeding of back-side welding on exposed steel surfaces. Grind smooth exposed fillet welds 1/2 inch and larger. Grind flush butt welds. Dress exposed welds.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.
   1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.

B. Bolted Connections: Field-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Bolted Connections: Field-bolted connections will be tested and inspected according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
   1. Direct-tension indicator gaps will be verified to comply with ASTM F 959, table 2.

D. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
   1. In addition to visual inspection, all full penetration field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

      a. Liquid Penetrant Inspection: ASTM E 165.
      b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
      c. Ultrasonic Inspection: ASTM E 164.
      d. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level “2-2T.”

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
   1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
   2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

F. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
   1. Additional testing, at Contractor’s expense, will be performed to determine compliance of corrected Work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean field welds, bolted connections, abraded areas, and areas where galvanizing is damaged or missing and apply galvanizing repair paint to comply with ASTM A 780.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, abraded areas, and exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils.

END OF SECTION 051200

SECTION 052100 - STEEL JOISTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions apply to this section.

1.2 SECTION INCLUDES

A. Short spans and long span joists.

B. Bridging, anchorages, headers and framing required to make a complete and rigid job.

C. Wall anchors at the ends of each line of bridging.

D. Shop painting, cleaning and touch-up of paint at field welds and at other points where shop coat is damaged.

1.3 RELATED WORK

A. All other sections of Division 5, Metals.

B. Div. 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4,16a-38k-4(b)5,16a-38k-4(d)9,16a-38k-4(d)11:
1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.4 DESIGN CRITERIA

A. Building structure designed based on SJI. joist sizes selected and shown on the drawings.

B. Allowable Deflection: Design and fabricate for a maximum deflection of L/360 of the clear span including the required uniform live load, for all areas having suspended ceilings below.

C. Top Chords: Design for combined bending and direct stresses for live and dead loads. Top chord extensions shall extend back into joist to fully develop bending and shear stresses.

1. In addition, steel joists and joist girders furnished shall be designed to support the special loading requirements and fixed-end wind moments indicated on the drawings.

D. Wind Uplift: All bar joists shall be designed to resist a net wind uplift of 30 psf for a 12’-0” x12’-0” area at all exterior building corners, 30 psf for a 12’-0” width around the entire building perimeter, and 23 psf for all other roof areas. Locate bridging near the first bottom chord panel point and design all joist members to satisfy this additional loading condition.

1.5 QUALITY ASSURANCE

A. Joists: Fabricated in compliance with the references, specifically the requirements of span and loading as indicated by joist designation on the drawings.

B. Manufacturers Qualifications: Member Steel Joist Institute.

C. Welding Qualifications: Qualify welding processes and welders in accordance with the AWS - "Standard Qualification Procedure."

1.6 REFERENCES

A. Steel Joist Institute (SJI.):
- Standard Specifications and Load Tables - Open Web Steel Joists
- Short Span Steel Joists - K Series
- Deep Long Span Steel Joists – LH and DLH Series

B. American Institute of Steel Construction (AISC): "Manual of Steel Construction"

1. Allowable Stress Design (ASD) - Ninth Edition
2. Load and Resistance Factor Design (LRFD) - Third Edition

C. American Iron and Steel Institute (AISI): Specification for the Design of Cold-Formed Steel Structural Members

D. Steel Structures Painting Council (SSPC): Steel Structures Painting Manual, Volume 1 and Volume 2, Systems and Specifications, by Steel Structures Painting Council.

E. American Welding Society (AWS): D1.1 Structural Welding Code Standard Qualification Procedures

1.7 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.2-1.05.02 and NOTICE TO CONTRACTOR-SUMITTALS.

B. Shop Drawings: Show layout of joist units, special connections, jointing and accessories. Include the mark, number, type, location and spacing of joists and bridging.

C. Design Computation: Provide design computation for all steel joists with special loads beyond those required by the standard joist tables. Computations shall be submitted under the seal and signature of registered professional Structural Engineer in the State of Connecticut.

1. See drawings for location of steel joists and joist girders with special loading requirements and fixed-end wind moments.

D. Certification: That joists comply with "AISC-SJI. Specifications".

E. Product Data: Specifications and installation instructions for each type of joist and its accessories.

1.8 DELIVERY, STORAGE HANDLING

A. Product Handling: As recommended in "AISC-SJI. Specifications". Handling and storage: Prevent deformation of members and excessive stresses.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel: Comply with "AISC-SJI. Specifications:

B. Threaded Fasteners:

1. ASTM A-325 or A-490 heavy hexagon structural bolts with nuts and hardened washers.

C. Prime Paint: AISC-SJI. Specifications, Type I Grey oxide; Type II Asphaltic not permitted.

2.2 SHORT SPAN STEEL JOISTS (K SERIES)

A. Design and fabricate in accordance with "AISC SJI. Standard Specifications and Load Tables for Short Span Steel Joists, K-Series."

B. Bearing Ends: Extend a minimum distance of 2-1/2 inches on steel supports, and a minimum of 4 inches on masonry and concrete supports.

C. All strut joists on column centerlines shall be designed to resist an additional wind fixed end moment of 15 kip-feet.

2.3 LONG SPAN STEEL JOIST (LH and DLH SERIES)

A. Design and fabricate in accordance with "AISC SJI. Standard Specifications and Load Tables for Long and Deep Long Span Steel Joist, LH and DLH-Series."

B. Bearing Ends: Extend a minimum distance of 4 inches on steel supports, and a minimum of 6 inches on masonry and concrete supports.

C. All strut joists on column centerlines shall be designed to resist an additional wind fixed end moment of 20 kip-feet.

2.4 FABRICATION

A. General: Fabricate in accordance with "AISC-SJI. Specifications."

1. Camber: Fabricate joists with camber as noted or indicated on drawings.

B. Extended Ends: Provide top chord extended ends on joists; design to support uniform loads indicated in "SJI. Specifications and Load Tables."

1. Design as cantilever beams with reactions carried back to not less than the first panel point of the joists.
2. Cantilevered extended ends shall be designed for a maximum live load deflection of the cantilevered length divided by 240 (Lc/240).

C. Ceiling Extension: Provide ceiling extensions in areas having ceilings attached directly to joist bottom chord.

1. Provide either an extended bottom chord element or a separate unit, to suit manufacturer's standards.
2. Sufficient strength to support the ceiling construction within deflection limit indicated.
3. Extend ends to within 1" of the finished wall surface, unless otherwise indicated.

D. End Anchorage and Bearing Plates: Provide end anchorages to secure joists to adjacent construction, comply with "AISC-SJI. Specifications" except as indicated.

1. Include beveled end bearings for installations where slope exceeds 1/4 inch (6.35 mm) in 12 inches (304.8 mm).

E. Header Units: Provide header units to support tail joists at openings in floor or roof system.

F. Bridging and Sag Rods: Provide bridging, sag rods and anchors for ends of lines, terminate at walls or beams.

G. Shop Painting: Shop paint all steel joists and joist girders except members or portion of members to be embedded in concrete or sprayed on fireproofing. Paint embedded steel on exposed portions and initial 2 inches of embedded areas only.

1. Remove loose scale, heavy rust, and other foreign materials from joists and accessories before application of shop paint in accordance with SSPC SP-2 "Hand Tool Cleaning" and SP-3 "Power Tool Cleaning."
2. Remove oil, grease and similar contaminants in accordance with SSPC SP-1 "Solvent Cleaning."
3. Apply one shop coat of rust inhibitive prime paint to steel joists and accessories, by spray, dipping, or other method.
4. Provide continuous minimum dry film thickness of not less than 1.0 mils.
5. Another coat shall be applied, at the time of erection, if the original protection has deteriorated in any manner.

PART 3 - EXECUTION

3.1 PREPARATION

A. Erector must examine the areas and conditions under which steel joists are to be installed and provide notification in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.

3.2 ERECTION

A. Placing Joists: Place and secure steel joist in accordance with "AISC-SJI. Specifications" and as herein specified. Place joists on supporting work, adjust and align in accurate locations and spacing before permanently fastening.

1. Provide temporary bridging, connections, and anchors to ensure lateral stability during construction.
2. Do not place construction loads upon joists, until joists and bridging are securely in place.
3. Maximum spacing of joists is shown in plans on the structural drawings. Joists shall be spaced less than maximum distance shown in plans where it is necessary to avoid pipes,

openings, parallel partitions, etc.

4. Set joists accurately, in proper locations. Alignment of each joist in place shall not deviate more than 3/8" in 10 feet from a straight line.
5. Bearing surfaces of the joists shall be in the same plane with full bearing on supports and anchored as indicated. For joist ends bearing on masonry, provide solid level bearing of 8" minimum depth filled with concrete.
6. Strut joists at columns shall have top chords bolted to structural members and the bottom chords shall be extended. Both top and bottom chords shall be welded to structural members after field adjustments. See structural details.

B. Attachment:

1. Welding: Field weld joists to supporting steel frame work in accordance with AISC-SJI. Specifications for the type of joists used. Coordinate welding sequence and procedure with the placing of joists.
2. Anchors: Furnish anchor bolts and other devices to be built into concrete and masonry construction. Furnish templates for accurate location of anchors to other work. Hook anchors not permitted.

C. Bridging:

1. Install bridging immediately after joists are erected. Brace end joists laterally by anchors or ties at each line of bridging.
2. Type as noted or detailed on structural drawings. Bridge both bottom and top chords. Weld all bridging.

   a) Install parallel bridging for short span joist and promptly after placing joist.
   b) Where 4 or 5 rows of bridging are required, a row nearest the midspan of the joist shall be diagonal bridging with bolted connections at chords and intersections.

3. Interruption of bridging: (e.g. ducts, suspended HVAC units, recessed light fixtures, etc.) Provide bridging at each end of such items that will overlap line of standard bridging.
4. Joists to be exposed in finished areas: Erect bridging in line with all sections straight, neatly installed and coordinated with building features.

3.3 PROTECTION

A. Distribute all construction loads so that carrying capacity of each joist is not exceeded.

B. Joists shall not be moved or cut, after permanently set, except under written direction of the Architect.

3.4 DEFECTIVE WORK

A. Joists with bent chords or web members, poor welds or other defects, will be rejected and must be replaced with material meeting these specifications.

3.5 TOUCH-UP PAINTING

A. After joist installation, paint all field bolt heads and nuts, and welded areas, abraded or rusty surfaces on joists and steel supporting members. Wire brush surfaces and clean with solvent before painting. Use the same type of paint as used for shop painting.

3.6 INSPECTION AND TESTING

A. General: Joists welded in place are subject to inspection and testing. Expense of removing and replacing any portion of the steel joists for testing purposes will be borne by the Owner if welds are found to be satisfactory. Remove and replace any work found to be defective and provide new acceptable work.

1. The Owner shall employ and pay for an inspection agency approved by the Architect to inspect the joist.
2. Documents: Provide the inspection agency with a complete set of Contract Documents and approved shop drawings before the work is started.
3. Notification: The Contractor shall notify the inspection agency before the start of erection of steel joists in order that the inspector may properly schedule the required inspections.

B. Mill Test Reports:

1. Furnish the inspection agency a copy of the certified mill test reports of chemical analysis and physical test for each heat number of structural steel.
2. Furnish an affidavit (six copies) from steel manufacturer, stating that steel furnished for the project complies with the specifications.

C. Shop Inspection includes:

1. General inspection of the joist fabrication, including welding and required camber.
2. Shop inspection shall be made in the field prior to erection of joist.
3. Mill Certificates shall be reviewed and approved by the inspection agency prior to fabrication.

D. Field Inspection includes:

1. Setting of bearing plates when required.
2. Field welding of joists to supports.
3. Bridging installation and materials.
4. Anchorage requirements called for on the drawings.
5. Alignment of adjacent joists.
6. Field touch-up of paint and painting of field welds prior to placement of deck.

E. Written Certification:

1. Upon completion of the installation of all steel joists, the inspection agency shall submit written certification that the joists as manufactured meet all the requirements of the Contract Documents.

3.7 CONTRACTOR'S RESPONSIBILITY

A. Acceptance of the shop and field inspection done by the testing agency pertaining to the structural steel, does not relieve the Contractor of his responsibility to insure that the project has the proper sizes, strength, fabrication and erection procedures and any other requirements of the Contract Documents.

B. Submit copies of all reports indicating conformance and exceptions to contract documents in a timely fashion to General Contractor for distribution to design consultants, owner, subcontractors and other interested parties.

C. Final Report: The Inspection Agency shall prepare a written report that summarizes the work inspected during the course of the project, and certifies that the work meets the requirements of the contract documents, specifications, and all governing agencies.

END OF SECTION 052100

SECTION 053100 **-** STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions ,apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Roof deck.
   2. Composite floor deck.
   3. Metal form deck.
   4. Stud shear connectors.

B. Related Sections:
   1. Section 03 30 00 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill and reinforcing steel over steel deck.
   2. Section 05 12 00 "Structural Steel Framing" for shop- and field-welded shear connectors.
   3. Section 05 50 00 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
   4. Section 09 91 23 "Interior Painting" for repair painting of primed deck and finish painting of deck.
   5. Div. 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4,16a-38k-4(b)5,16a-38k-4(d)9,16a-38k-4(d)11:
      1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.2-1.05.02 and NOTICE TO CONTRACTOR-SUMITTALS.

B. Product Data: For each type of deck, accessory, and product indicated.

C. Shop Drawings:
   1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.
      a. For steel deck indicated to comply with certain design loadings, include structural analysis data sealed and signed by the qualified professional engineer who was responsible for its preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates signed by Contractor certifying that welders comply with requirements specified under the Part 1.1 of this Section.

B. Product Certificates: Signed by manufacturers of steel deck certifying that their products comply with specified requirements.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
   1. Mechanical fasteners.

D. Research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence steel deck's compliance with the building code in effect for the Project.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
   1. Work shall be performed in compliance with Owner's insurance underwriters' requirements.

B. Engineer Qualifications: A structural engineer licensed in the state where Project is located and experienced in providing engineering services of the kind indicated that have resulted in the installation of steel deck similar to this Project in material, design, and extent, and that has a record of successful in-service performance.

C. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1 "Structural Welding Code – Steel" and AWS D1.3, "Structural Welding Code - Sheet Steel."
   1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

E. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1.7 COORDINATION

A. Coordinate installation of trench headers, preset inserts, and duct fittings in cellular metal floor deck with related units of Work specified in other Sections prior to casting concrete slab.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: Subject to compliance with requirements, provide products by one of the following:
   1. ASC Profiles, Inc.; a Blue Scope Steel company.
   2. Consolidated Systems, Inc.; Metal Dek Group.
   3. Epic Metals Corporation.

2.2 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Where indicated, provide steel deck panels identical to those tested as part of an assembly for fire resistance per ASTM E 119 by a testing and inspecting agency performing testing and follow-up services that is acceptable to authorities having jurisdiction.
   1. Fire-Resistance Ratings: As indicated by design designations listed in UL “Fire Resistance Directory,” or by Warnock Hersey or another qualified testing and inspecting agency.
   2. Labeling: Identify steel deck with appropriate markings of applicable testing and inspecting agency.

2.3 ROOF DECK

A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
   1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade A, G90 zinc coating.
   2. Deck Profile: Type WR, wide rib.
   3. Profile Depth: 1-1/2 inches.
   4. Thickness: As indicated on Drawings.
   5. Span Condition: As indicated.
   6. Side Laps: Interlocking seam.

2.4 COMPOSITE FLOOR DECK

A. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite

Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Prime-Painted Steel Sheet: ASTM A 611, Grade C, shop primed as follows:

    a. Shop Primer: Gray or white baked-on, lead- and chromate-free rust-inhibitive primer, conforming to the performance requirements of Fed. Spec. TT-P-664.
2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Grade A, G90 zinc coated according to ASTM A 653.
3. Profile Depth: As indicated.
4. Thickness: As indicated.
5. Span Condition: As indicated.

2.5 ACCESSORIES

A. General: Provide accessory materials for steel deck that comply with requirements indicated and recommendations of the steel deck manufacturer.

B. Side-Lap Fasteners: Manufacturer’s standard. corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

C. Flexible Rib Closure Strips: Manufacturer’s standard vulcanized, closed-cell, synthetic rubber.

D. Miscellaneous Roof Deck Accessories: Steel sheet, not less than 0.0359-inch design uncoated thickness, ridge and valley plates, finish strips, and reinforcing channels of same material as roof deck.

E. Pour Stops and Girder Fillers: Steel sheet, of same material and finish as deck, and of thickness and profile indicated.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material and thickness as deck panels, unless otherwise indicated.

G. Hanger Tabs: Manufacturer’s standard piercing steel sheet hanger attachment devices for use with floor deck panels.

H. Weld Washers: Manufacturer’s standard uncoated steel sheet weld washers, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.

I. Flat Receiver Pan: Manufacturer’s standard size, single-piece steel sheet, 0.071 inch thick minimum units, of same material as deck panels. For drains, cut holes in the field.

J. Recessed Sump Pans: Manufacturer’s standard size, single-piece steel sheet, 0.071 inch thick minimum, of same material as deck panels, with 3-inch- wide flanges and level recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

K. Shear Connectors: ASTM A 108, Grade 1010 through 1020 headed stud type, cold-finished carbon steel, AWS D1.1, Type B.

L. Steel Sheet Accessories: ASTM A 446, G90 coating class, galvanized according to ASTM A 653/A 653M.

M. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel decking.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Do not place deck panels on concrete supporting structure until concrete has cured and is dry.

B. Locate decking bundles to prevent overloading of supporting members.

3.3 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

3.4 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
   1. Weld Diameter: per drawings.

2. Weld Spacing: Weld edge ribs of panels at each support. Space welds as shown in Drawings, with a minimum of one welds per rib at each support. Provide closer spacing as noted for in-plane diaphragm force and uplift resistance. In addition, secure deck to each supporting member in ribs where side laps occur.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as shown in Drawings, but at intervals not exceeding 36 inches, using one of the following methods:
1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
2. Fasten with a minimum of 1-1/2-inch- long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
1. End Joints: Lapped 2 inches minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.5 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
1. Weld Diameter: 5/8 inch, nominal.
2. Weld Spacing: Space and locate welds as indicated on Drawings.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding 36 inches, using one of the following methods:
1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
2. Fasten with a minimum of 1-1/2-inch- long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
1. End Joints: Butted.

D. Shear Connectors: Weld shear connectors through deck to support framing according to AWS D1.1 and manufacturer’s instructions. Butt end joints of deck panels; do not overlap.
1. Where welded shear connectors are applied through deck, such shear connectors may take the place of a fusion weld above on a one-for-one basis.
2. Break ceramic ferrules (arc shields) loose and remove from deck.

E. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

F. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of decking. Weld cover plates at changes in direction of floor deck panels, unless otherwise indicated.

G. Install piercing hanger tabs not more than 14 inches apart in both directions, within 9 inches of walls at ends, and not more than 12 inches from walls at sides unless otherwise indicated.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Shear connector welds will be inspected and tested according to the requirements of AWS D1.1 for stud welding and as follows:
   1. Shear connector welds will be visually inspected.
   2. Bend tests will be performed when visual inspections reveal either less than a continuous 360 degree flash or welding repairs to any shear connector.
   3. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested according to the requirements of AWS D1.1

D. Testing agency will report inspection results promptly and in writing to Contractor and Owner.

E. Remove and replace work that does not comply with specified requirements.

F. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.7 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brush, clean, and paint abraded areas, welds, and rust spots on both surfaces of deck panels immediately after installation.
   1. Touch up painted surfaces with same type of shop paint used on adjacent surfaces.
   2. Where shop-painted surfaces are exposed in-service, apply touchup paint to blend into adjacent surfaces.

C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Exterior and interior non-load-bearing wall framing.
   2. Ceiling joist framing.
   3. Soffit framing.

B. Related Requirements:

   1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4: 16a-38k-4(b)5, 16a-38k-4(d)9
      a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

   2. Section 055000 "Metal Fabrications" for masonry shelf angles and connections.
   3. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
   4. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of cold-formed steel framing product and accessory.

C. Shop Drawings:

   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.

2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

D. Delegated-Design Submittal: For cold-formed steel framing.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Dietrich Metal Framing; a Worthington Industries Company.
2. MarinoWARE.
3. Steel Network, Inc. (The).

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, licensed in the State of Connecticut to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on structural drawings.
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
   a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

   a. Upward and downward movement of 1 inch (25 mm).

5. Design exterior and interior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Design Standards:
1. Wall Studs: AISI S211.
2. Headers: AISI S212.
3. Lateral Design: AISI S213.

D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by structural performance.
2. Coating: G60 (Z180).

B. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance.
2. Coating: G60 (Z180).

2.4 EXTERIOR AND INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: 1-5/8 inches (41 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: 1-1/4 inches (32 mm).

C. Vertical Deflection Clips: Manufacturer's standard bypass and/or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dietrich Metal Framing; a Worthington Industries company.
b. MarinoWARE.
c. Steel Network, Inc. (The).

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).

2. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications.

E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.5 CEILING JOIST FRAMING

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0677 inch .
2. Flange Width: 1-5/8 inchesminimum.

2.6 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch
2. Flange Width: 1-5/8 inches, minimum.

2.7 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.8 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

E. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.10 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR AND INTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches (406 mm),unless otherwise indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to bypassing studs and anchor to building structure.
4. Connect drift clips to cold-formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

a. Install solid blocking as required by structural performance and at centers indicated on Shop Drawings.

2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 JOIST INSTALLATION

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.

1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.

C. Space joists not more than 2 inches from abutting walls unless noted, and as follows:

1. Joist Spacing: 16 inches.

D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on Shop Drawings.

1. Install web stiffeners to transfer axial loads of walls above.

F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:

1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.6 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel framing and supports for overhead doors.
2. Steel framing and supports for countertops.
3. Steel framing and supports for mechanical and electrical equipment.
4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
5. Elevator machine hoist beams, attachment plates and angle brackets, structural steel shapes for subsills and cants in hoistways made from steel shape.
6. Metal ladders.
7. Elevator pit sump covers.
8. Steel door frames.
9. Miscellaneous steel trim including steel angle corner guards and steel edgings.
10. Metal bollards.
11. Pipe guards.
12. Abrasive metal nosings.
13. Loose bearing and leveling plates for applications where they are not specified in other Sections.
14. Discharge identification barrier gates.
15. Tire chain rack.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
4. Expanded Metal Lath

C. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-4(d)9 and 16a-38k-4(d)11

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 033000 "Cast-in-Place Concrete" for installing embedded items such as anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
3. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
4. Section 051200 "Structural Steel Framing."
5. Section 055100 "Metal Stairs".
6. Section 057300 "Decorative Metal Railings."

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For the following:

1. Metal nosings and treads.
2. Paint products.
3. Grout.

C. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Elevator machine hoist beams.
4. Steel shapes for supporting elevator door sills.
5. Metal ladders.
6. Elevator pit sump covers.
7. Steel door frames. Miscellaneous steel trim including steel angle corner guards and steel edgings.
8. Metal bollards.

9. Pipe guards.
10. Abrasive metal nosings.
11. Loose steel lintels.

1.5 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.

D. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

E. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

F. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

G. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: 1-5/8 by 1-5/8 inches (41 by 41 mm).
2. Material: Galvanized steel, ASTM A 653/A 653M, structural steel, Grade 33 (Grade 230), with G90 (Z275) coating; 0.064-inch (1.6-mm) nominal thickness.

H. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

I. Expanded-Metal, Carbon Steel: ASTM F 1267, Type II (expanded and flattened)], Class 1 (uncoated).

1. Style Designation: 1-1/2 number 9.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
1. Provide stainless-steel fasteners for fastening stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy Group 1 (A1).

D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

F. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or

ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

G. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

H. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings.".

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

E. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

F. Heavy Duty Self Closing Hinge: Self-closing gravity weld on hinge that attcahes between gate post.
1. Basis-of-Design: provide 213000; Hardware Source.
   a. Gap between gate and post: 2 ¼ inches.
   b. Hinge Height: 7 ¼ inches tall.
   c. Hinge Pin: ¾ inch diameter.
   d. Welding Plates: 3 3/8 inches x 1 ½ inches x 3/8 inches.
   e. Hinge Barrel: 1 ½ inches diameter.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain

structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.

2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with primer specified in Section 099600 "High-Performance Coatings" where indicated.

2.7 METAL LADDERS

A. General:

1. Comply with ANSI A14.3**,** except for elevator pit ladders.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space siderails: As indicated on drawings.
2. Siderails: Continuous, steel flat bars, with eased edges, size as indicated on drawings..
3. Rungs: As indicated on drawings.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.
7. Galvanize elevator pit ladders, including brackets.
8. Prime roof ladders, including brackets and fasteners, with primer specified in Section 099600 "High-Performance Coatings."

2.8 ELEVATOR PIT SUMP COVERS

A. Fabricate from welded or pressure-locked steel bar grating Limit openings in gratings to no more than 1 inch (25 mm) in least dimension.

B. Provide steel angle supports as indicated.

C. Fabricate structural-steel door frames from steel shapes, plates, and bars of size and to dimensions indicated, fully welded together., unless otherwise indicated. Plug-weld built-up members and continuously weld exposed joints. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than 10 inches (250 mm) o.c. Reinforce frames and drill and tap as necessary to accept finish hardware.

1. Provide with integrally welded steel strap anchors for securing door frames into adjoining concrete or masonry.

D. Extend bottom of frames to floor elevation.

E. Prime exterior steel frames with primer specified in Section 099600 "High-Performance Coatings."

2.9 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize exterior miscellaneous steel trim.

D. Prime miscellaneous steel trim with primer specified in Section 099600 "High-Performance Coatings."

2.10 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 80 steel pipe, as indicated.

1. Cap bollards with steel shapes as indicated.

B. Fabricate bollards with steel base plates as indicated on the drawings for bolting to concrete slab where indicated. Drill baseplates at all four corners for anchor bolts.

C. Galvanize metal bollards.

D. Prime bollards with primer specified in Section 099600 "High-Performance Coatings."

2.11 PIPE GUARDS

A. Fabricate pipe guards from 3/8-inch- (9.5-mm-) thick by 12-inch- (300-mm-) wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch (50-mm) clearance between pipe and pipe guard. Drill each end for two 3/4-inch (19-mm) anchor bolts.

B. Galvanize pipe guards.

2.12 ABRASIVE METAL NOSINGS

A. Extruded Units: Aluminum, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.

1. Basis-of-Design Product:: Subject to compliance with requirements, provide Model BSTTB; Babcock Davis Inc.

2. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.
3. Nosings: Two-piece units, with subchannel for casting into concrete steps.
   a. Width:
      1) 4 inches, where indicated.
      2) 10 inches, where indicated.

B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

C. Drill for mechanical anchors and countersink. Locate holes not more than 4 inches (100 mm) from ends and not more than 12 inches (300 mm) o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.

   1. Provide two rows of holes for units more than 5 inches (125 mm) wide, with two holes aligned at ends and intermediate holes staggered.

D. Apply bituminous paint to concealed surfaces of cast-metal units.

E. Apply clear lacquer to concealed surfaces of extruded units.

2.13 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates.

2.14 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Galvanize loose steel lintels located in exterior walls.

2.15 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.16 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.17 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, or masonry, or unless otherwise indicated.

1. Shop prime with primers specified in Section 099600 "High-Performance Coatings" are indicated.

C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Other Items: SSPC-SP 3, "Power Tool Cleaning."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

B. Where indicated, anchor bollards to existing construction with expansion anchors. Provide four 3/4-inch (19-mm) bolts at each bollard unless otherwise indicated.

C. Where indicated, anchor bollards in place with concrete footings. Center and align bollards in holes as indicated above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

D. Fill bollards solidly with concrete, flush with top surface. Field weld cap.

3.4 INSTALLING PIPE GUARDS

A. Provide pipe guards at exposed vertical pipes in parking garage where not protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four 3/4-inch (19-mm) bolts at each pipe guard. Mount pipe guards with top edge 26 inches (660 mm) above driving surface.

3.5 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.6 INSTALLING EXPANDED-METAL LATH

A. Expanded-Metal Lath: Install according to ASTM C 841.

3.7 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099600 "High Performance Coatings."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000

SECTION 055100 - METAL STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preassembled steel stairs with concrete-filled treads.
2. Ornamental steel-framed stairs.
3. Steel tube railings attached to metal stairs.
4. Steel tube handrails attached to walls adjacent to metal stairs.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-4(d)9 and 16a-38k-4(d)11.
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.
2. Section 033000 "Cast-in-Place Concrete" for concrete fill for stair treads and platforms. Section 055000 "Metal Fabrications" for metal nosings installed in metal stairs, metal ladders and discharge identification barrier gates.
3. Section 057300 "Decorative Metal Railings" for ornamental metal railings.
4. Section 096613 "Portland Cement Terrazzo Flooring"for terrazzo treads, risers and landings for ornamental steel-framed stairs.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.

C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

D. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: See structural drawings.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For metal stairs and the following:

1. Paint products.
2. Grout.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Samples for Initial Selection: For products involving selection of color, texture, or design.

E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

1. Preassembled Stairs: Commercial class.
2. Ornamental Stairs: Architectural class.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.

C. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

D. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.

E. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating, structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.

2.3 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

D. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

E. Lag Screws: ASME B18.2.1 (ASME B18.2.3.8M).

F. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).

G. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).

H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchorscapable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting".

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

E. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa) unless otherwise indicated.

F. Welded Wire Fabric: ASTM A 185/A 185M, 6 by 6 inches (152 by 152 mm), W1.4 by W1.4, unless otherwise indicated.

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint for Architectural class stairs, Type 2 welds: completely sanded joint, some undercutting and pinholes okay for Commercial class stairs. .

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.6 STEEL-FRAMED STAIRS

A. Stair Framing:

1. Fabricate stringers of steel channels and tubes.

a. Provide closures for exposed ends of channel and tube stringers.

2. Construct platforms of steel channel and headers and miscellaneous framing members as needed to comply with performance requirements.
3. Weld stringers to headers; weld framing members to stringers and headers.
4. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

B. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.067 inch (1.7 mm).

1. Steel Sheet: Uncoated cold-rolled steel sheet unless otherwise indicated.
2. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
3. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
4. Shape metal pans to include nosing integral with riser.
5. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

2.7 STAIR RAILINGS

A. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.

1. Rails and Posts: As indicated on the drawings.
2. Picket Infill: As indicated on the drawings.

B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay.

C. Form changes in direction of railings as follows:
1. By bending, where not indicated.
2. By radius bends of radius, where indicated.

D. Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

E. Close exposed ends of railing members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.

1. Connect posts to stair framing by direct welding unless otherwise indicated.
2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
3. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

2.8 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal stairs after assembly.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply SSPC-SP 3, "Power Tool Cleaning."

D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

F. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

3.2 INSTALLING RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

1. Anchor posts to steel by welding directly to steel supporting members.
2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.

B. Attach handrails to wall with wall brackets. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

END OF SECTION 055100

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel tube railings.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-4(d)9 and 16a-38k-4(d)11.
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 055100 "Metal Stairs" for steel tube railings associated with metal stairs.
3. Section 057300 "Decorative Metal Railings" for ornamental railings fabricated from pipes and tubes.
4. Section 096900 "Access Flooring" for railings included with access flooring.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Steel: 72 percent of minimum yield strength.

C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

   a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
   b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For the following:
1. Grout, anchoring cement, and paint products.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of pit openings and other construction contiguous with metal fabrications by field measurements before fabrication.

1.8 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.2 STEEL AND IRON

A. Tubing: ASTM A 513.

B. Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.3 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

F. Connections: Fabricate railings with welded connections unless otherwise indicated.

G. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.

3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

H. Form changes in direction as follows:
1. By flush bends.

I. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

J. Close exposed ends of railing members with prefabricated end fittings.

K. Brackets, Flanges, Fittings, and Anchors: Provide flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

L. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

M. For removable railing posts, fabricate slip-fit sockets from steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

N. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.7 STEEL AND IRON FINISHES

A. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with primers specified in Section 099600 "High-Performance Coatings".

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

C. Adjust railings before anchoring to ensure matching alignment at abutting joints.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.3 ANCHORING POSTS

A. Form or core-drill holes not less than 6 inches deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
   1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

C. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

   1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099600 "High-Performance Coatings."

3.5 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

SECTION 055300 - METAL GRATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal bar gratings.
2. Metal frames and supports for gratings.

B. Related Sections:

1. Section 033000 “CIP Concrete” for metal embed supporting gratings.

2. Section 051200 "Structural Steel Framing" for structural-steel framing system components.

3. Div. 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4,16a-38k-4(b)5,16a-38k-4(d)9,16a-38k-4(d)11:
1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design gratings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
1. Floors: Uniform load of 250 lbf/sq. ft. (11.97 kN/sq. m), HS20 truck loadings or concentrated load of 8000 lbf (35.60 kN), whichever produces the greater stress.
2. Sidewalks and Vehicular Driveways, Subject to Trucking: Uniform load of 250 lbf/sq. ft. (11.97 kN/sq. m) , HS20 truck loadings or concentrated load of 8000 lbf (35.60 kN), whichever produces the greater stress.
3. Limit deflection to L/360 or 1/4 inch (6.4 mm), whichever is less.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.2-1.05.02 and NOTICE TO CONTRACTOR-SUMITTALS.

B. Product Data: For the following:
   1. Clips and anchorage devices for gratings.
   2. Galvanization.

C. Shop Drawings: Include plans, sections, details, and attachments to other work.

D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:

   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 FERROUS METALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

D. Wire Rod for Bar Grating Crossbars: ASTM A 510 (ASTM A 510M).

E. Uncoated Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30 (Grade 205).

F. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating.

2.2 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F 593 (ASTM F 738M) for bolts and ASTM F 594 (ASTM F 836M) for nuts, Alloy Group 2 (A4).

D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).

F. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).

G. Post-Installed Anchors: chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 2 (A4) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.3 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy that is welded.

B. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings.".

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

2.4 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.

E. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

1. Fabricate toeplates to fit grating units and weld to units in shop unless otherwise indicated.
2. Fabricate toeplates for attaching in the field.
3. Toeplate Height: 4 inches (100 mm) unless otherwise indicated.

2.5 METAL BAR GRATINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
2. All American Grating.
3. BarnettBates Corporation.

B. Welded Steel Grating [MBG-<#>]:

1. Bearing Bar Spacing: 15/16 inch (24 mm) o.c. Min.
2. Bearing Bar Depth: 2 inches (51 mm).
3. Bearing Bar Thickness: As required to comply with structural performance requirements.
4. Crossbar Spacing: 4 inches (102 mm) o.c. Max.
5. Traffic Surface: Serrated or Knurled.
6. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. (550 g/sq. m) of coated surface.

C. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

1. Provide no fewer than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.
2. Provide no fewer than four saddle clips for each grating section composed of rectangular bearing bars 3/16 inch (4.8 mm) or less in thickness and spaced 15/16 inch (24 mm) or more o.c., with each clip designed and fabricated to fit over two bearing bars.
3. Provide no fewer than four weld lugs for each grating section composed of rectangular bearing bars 3/16 inch (4.8 mm) or less in thickness and spaced less than 15/16 inch (24 mm) o.c., with each lug shop welded to three or more bearing bars. Interrupt intermediate bearing bars as necessary for fasteners securing grating to supports.
4. Provide no fewer than four flange blocks for each section of aluminum I-bar grating, with block designed to fit over lower flange of I-shaped bearing bars.
5. Furnish threaded bolts with nuts and washers for securing grating to supports.
6. Furnish self-drilling fasteners with washers for securing grating to supports.
7. Furnish galvanized malleable-iron flange clamp with galvanized bolt for securing grating to supports. Furnish as a system designed to be installed from above grating by one person.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Kee Industrial Products, Inc.; Grating Clip.
2) Lindapter North America, Inc.; Grate-Fast.
3) All American Grating..

D. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.

E. Do not notch bearing bars at supports to maintain elevation.

2.6 STEEL FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish gratings, frames, and supports after assembly.

C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Attach toeplates to gratings by welding at locations indicated.

F. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.3 INSTALLING EXPANDED-METAL GRATINGS

A. General: Comply with manufacturer's written instructions for installing gratings.

B. Place units with straight edge of bond up and with long direction of diamond-shaped openings parallel to direction of span.

C. Attach removable units to supporting members by bolting at 6-inch (150-mm) intervals.

D. Attach nonremovable units to supporting members by welding unless otherwise indicated. Space welds at 6-inch (150-mm) intervals.

E. Attach aluminum units to steel supporting members by bolting at 6-inch (150-mm) intervals.

F. Butt edges parallel to long direction of diamond-shaped openings and weld at every second bond point. Place individual grating sections so diamonds of one piece are aligned with those of adjacent sections.

3.4 INSTALLING METAL PLANK GRATINGS

A. General: Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard anchor clips and hold-down devices for bolted connections.

B. Attach removable units to supporting members by bolting at every point of contact.

C. Attach nonremovable units to supporting members by welding unless otherwise indicated. Comply with manufacturer's written instructions for size and spacing of welds.

D. Attach aluminum units to steel supporting members by bolting at side channels at every point of contact and by bolting intermediate planks at each end on alternate sides. Bolt adjacent planks together at midspan.

3.5 INSTALLING GLASS-FIBER-REINFORCED PLASTIC GRATINGS

A. Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard stainless-steel anchor clips and hold-down devices for bolted connections.

3.6 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055300

SECTION 057300 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Stainless-steel decorative railings with glass infill.

B. Related Sections:

   1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)5 and 16a-38k-4(b)4.
      a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

   2. Section 055100 "Metal Stairs" for steel tube railings included with metal stairs.
   3. Section 055213 "Pipe and Tube Railings" for railings fabricated from pipe and tube components.

1.3 DEFINITIONS

A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas, pedestrian guidance and support, visual separation, or wall protection.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
   1. Stainless Steel: 60 percent of minimum yield strength.

C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

   1. Handrails and Top Rails of Guards:

      a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.

b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Samples for Initial Selection: For products involving selection of color, texture, or design**,** including mechanical finishes.

E. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.

F. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

D. Preconstruction test reports.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of railings and are based on the specific system indicated.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

C. Safety Glazing Labeling: Permanently mark glass with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.9 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Inox; HDI Railing Systems.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.3 STAINLESS STEEL

A. Sheet: ASTM, 303 UNS 1.4305, type 304.

2.4 GLASS AND GLAZING MATERIALS

A. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type 1 (transparent flat glass), Quality-Q3. Provide products that have been tested for surface and edge compression according to ASTM C 1048 and for impact strength according to 16 CFR 1201 for Category II materials.

1. Glass Color: Clear.
2. Thickness for Glass Infill Panels: As required by structural loads, but not less than 8**.0** mm.

2.5 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. Stainless-Steel Components: Type 304 stainless-steel fasteners.
2. Dissimilar Metals: Type 304 stainless-steel fasteners.

B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.

D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

E. Post-Installed Anchors: Torque-controlled expansion anchors.
1. Material for Stainless Steel Locations: Alloy Group 1 (A1) or Group 2 (A4) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.6 MISCELLANEOUS MATERIALS

A. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.7 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage**,** but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with nonwelded connections unless otherwise indicated.

H. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

I. Form changes in direction as follows:

1. By flush bends or by inserting prefabricated flush-elbow fittings.
2. By bending to smallest radius that will not result in distortion of railing member.

J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

K. Close exposed ends of hollow railing members with prefabricated end fittings.

L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

O. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

2.8 GLAZING PANEL FABRICATION

A. General: Fabricate to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.

1. Clean-cut or flat-grind edges at butt-glazed sealant joints to produce square edges with slight chamfers at junctions of edges and faces
2. Grind smooth exposed edges, including those at open joints, to produce square edges with slight chamfers at junctions of edges and faces.

B. Infill Panels: Provide tempered glass panels.

2.9 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.10 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Finish: 240 grain/ grit (No. 4. Dull).

C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine stair assemblies, to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

C. Corrosion Protection: Coat concealed surfaces of stainless steel that will be in contact with concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.4 ANCHORING POSTS

A. Anchor posts to stringers with side mount as indicated on the drawings.

3.5 INSTALLING GLASS PANELS

A. Post-Supported Glass Railings: Install assembly to comply with railing manufacturer's written instructions and with requirements in other Part 3 articles. Erect posts and other metal railing components, then set factory-cut glass panels. Do not cut, drill, or alter glass panels in field. Protect edges from damage.

3.6 CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

B. Clean and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057300

SECTION 057500 - DECORATIVE FORMED METAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior metal wall cladding.
2. Interior metal wall cladding accessories.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(6)4 and 16a-38k-4(b)5.
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.
2. Section 055000 "Metal Fabrications" for non-decorative metal fabrications.
3. Section 057300 "Decorative Metal Railings."
4. Section 076200 "Sheet Metal Flashing and Trim" for items made of formed metal for flashings and trim.
5. Section 077100 "Roof Specialties" for items made of formed metal for parapets and copings.
6. Section 081113 "Hollow Metal Doors and Frames" for flush hollow-metal doors and frames receiving decorative metal cladding.
7. Section 142100 "Machine-Room-Less Traction Elevators" for elevator cab and entrance components made from sheet metal.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include finishing materials.

C. Shop Drawings: Show fabrication and installation details for decorative formed metal.

1. Include plans, elevations, component details, and attachments to other work.
2. Indicate materials and profiles of each decorative formed metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

D. Samples for Verification: For each type of exposed finish required, prepared on 6-inch- (150-mm-) square Samples of metal of same thickness and material indicated for the Work.

1.4 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by stainless-steel manufacturers certifying that products furnished comply with requirements.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing decorative formed metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Installer Qualifications: Fabricator of products.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver decorative formed metal products wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

B. Store products on elevated platforms in a dry location.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with decorative formed metal by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 COORDINATION

A. Coordinate installation of decorative formed metal with adjacent construction.

PART 2 - PRODUCTS

2.1 SHEET METAL

A. General: Provide sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.

B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness.

2.2 MISCELLANEOUS MATERIALS

A. Sealants, Interior: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834; of type and grade required to seal joints in decorative formed metal; and as recommended in writing by decorative formed metal manufacturer.

B. Backing Materials: Provided or recommended by decorative formed metal manufacturer.

C. Laminating Adhesive: Adhesive recommended by metal fabricator that will fully bond metal to metal and that will prevent telegraphing and oil canning and is compatible with substrate and noncombustible after curing.

2.3 FABRICATION, GENERAL

A. Shop Assembly: Preassemble decorative formed metal items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of decorative formed metal items with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

C. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch- (12-mm-) wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch (1 mm) and support with concealed stiffeners.

D. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.

   1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.

E. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install decorative formed metal items.

2.4 INTERIOR METAL WALL CLADDING (PNL-1)

   1. Basis-of-Design Product: Subject to compliance with requirements, provide Tread Plate, pattern XTP; Rigidized Metals Corporation.

B. Form interior metal wall cladding from metal of type and thickness indicated below. Fabricate to fit tightly to adjoining construction.

   1. Stainless-Steel Sheet: 0.050 inch (1.27 mm).

      a. Finish: No. 4. (satin, polish directional finish)

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish items indicated on Drawings after assembly.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative formed metal.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare the surfaces using the methods recommended by the manufacturer.

3.3 INSTALLATION

A. Install in accordance with the manufacturer’s instructions.

B. Locate and place decorative formed metal items level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install decorative formed metal.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

C. Use concealed anchorages where possible.

D. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

E. Install reveal trim and accessories as the Work progresses.

3.4 ADJUSTING AND CLEANING

A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.5 PROTECTION

A. Protect finishes of decorative formed metal items from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 057500

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Rooftop equipment bases and support curbs.
2. Wood blocking, cants, and nailers.
3. Wood furring and grounds.
4. Wood sleepers.
5. Plywood backing panels.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4, 16a-38k-4(b)5 and 16a-38k-4(d)13.

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 061600 "Sheathing."

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NHLA: National Hardwood Lumber Association.
3. NLGA: National Lumber Grades Authority.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

   1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

D. Application: Treat items indicated on Drawings, and the following:

   1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
   2. Wood sills, sleepers, blocking,furring, stripping, and similar concealed members in contact with masonry or concrete.
   3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
   4. Wood framing members that are less than 18 inches (460 mm) above the ground.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

   1. Use treatment that does not promote corrosion of metal fasteners.
   2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

E. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

F. Application: Treat items indicated on Drawings, and the following**:**
1. Furring for interior wood board paneling.Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Cants.
4. Furring.
5. Grounds.

B. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber and any of the following species:

1. Hem-fir (north); NLGA.
2. Mixed southern pine; SPIB.
3. Spruce-pine-fir; NLGA.
4. Hem-fir; WCLIB or WWPA.
5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
6. Western woods; WCLIB or WWPA.
7. Northern species; NLGA.
8. Eastern softwoods; NeLMA.

C. For furring behind interior wood board paneling, provide No.2 Stud, grade lumber and any of the following species:

1. Hem-fir (north); NLGA.
2. Hem-fir; WCLIB or WWPA.

D. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine, No. 3 grade; SPIB.
2. Hem-fir or hem-fir (north), Standard or No. 3 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir, Standard or No. 3 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
4. Eastern softwoods, No. 3 Common grade; NELMA.
5. Northern species, No. 3 Common grade; NLGA.
6. Western woods, Standard or No. 3 Common grade; WCLIB or WWPA.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153Mor of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Metal Framing: ASTM C 954, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

G. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.7 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

E. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water, except sill plates.
2. Use copper naphthenate for items not continuously protected from liquid water.

G. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in "2005 Connecticut Supplement with 2009 Amendment – State Building Code."

H. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

3.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Sheathing joint and penetration treatment.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4 and 16a-38k-4(d)13.
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.
2. Section 072713 "Modified Bituminous Sheet Air Barriers" for air -resistive barrier applied over wall sheathing.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

2.2 WALL SHEATHING

A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corporation; GlasRoc.
b. G-P Gypsum Corporation; Dens-Glass Gold.
c. National Gypsum Company; Gold Bond e(2)XP.

2. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.
3. Size: 48 by 96 inches (1219 by 2438 mm**)**for vertical installation.

2.3 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153Mor of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C 1002.

2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C 954.

2.4 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule, "2005 Connecticut Supplement with 2009 Amendment – State Building Code."

D. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.
1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install boards with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.

3. Install boards with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.

D. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 061600

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior board paneling.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits MR5, MR, MR7, IEQ4.1.

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 061053 "Miscellaneous Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
3. Section 099123 "Interior Painting" for priming and backpriming of interior finish carpentry.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.
1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.
3. Include copies of warranties from chemical-treatment manufacturers for each type of treatment.

C. Samples for Verification:
1. For each finish system and color of lumber and panel products with factory-applied finish, 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For fire-retardant-treated wood, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

B. Deliver interior finish carpentry materials only when environmental conditions meet requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and the following grading rules:

1. NeLMA: Northeastern Lumber Manufacturers' Association, "Standard Grading Rules for Northeastern Lumber."
2. NHLA: National Hardwood Lumber Association, "Rules for the Measurement and Inspection of Hardwood & Cypress."
3. NLGA: National Lumber Grades Authority, "Standard Grading Rules for Canadian Lumber."
4. SPIB: The Southern Pine Inspection Bureau, "Standard Grading Rules for Southern Pine Lumber."
5. WCLIB: West Coast Lumber Inspection Bureau, Standard No. 17, "Grading Rules for West Coast Lumber."
6. WWPA: Western Wood Products Association, "Western Lumber Grading Rules."

B. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.

1. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

C. Hardboard: AHA A135.4.

2.2 FIRE-RETARDANT-TREATED MATERIALS

A. General: For applications indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction, and comply with testing requirements; testing by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Class A products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent respectively.

C. For exposed items indicated to receive a stained or natural finish, use organic resin chemical formulations that do not contain colorants, and provide materials that do not have marks from spacer sticks on exposed face.

D. Do not use material that does not comply with requirements for untreated material or is warped or discolored.

E. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each pieceor omit marking and provide certificates of treatment compliance issued by inspection agency.

F. Application: All interior wood-board paneling to be fire-retardant-treated.

2.3 INTERIOR TRIM

A. Softwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade: Siberian Spruce.
   a. Basis-of-Design Product: Subject to compliance, provide reclaimed wood product from Viridian Reclaimed Wood.
2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
3. Finger Jointing: Not allowed.
4. Face Surface: Surfaced (smooth).

2.4 PANELING

A. Board Paneling: Interior wood-board paneling.

1. Species: Siberian Spruce.
2. Grade: Knotty No. 1.
3. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
4. Pattern: Tongue and groove.
5. Net Coverage Width: Not less than 3 inches.
6. Thickness; 3/4 inch.
7. Lengths: 4 feet to 8 feet.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

2.6 FABRICATION

A. Back out or kerf backs of the following members except those with ends exposed in finished work:
1. Wood-board paneling.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, too small to fabricate with proper jointing arrangements, or with defective surfaces, sizes, or patterns.

B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
2. Face fastening is prohibited..
3. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
4. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.4 PANELING INSTALLATION

A. Board Paneling: Install according to manufacturer's written instructions. Arrange in random-width pattern suggested by manufacturer unless boards or planks are of uniform width.
1. Stagger end joints in random pattern to uniformly distribute joints on each wall.
2. Locate end joints only over furring or blocking.
3. Fasten paneling by blind nailing through tongues.

3.5 ADJUSTING

A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.6 CLEANING

A. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes, if any.

3.7 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062023

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior standing and running trim.
2. Wood cabinet doors.
3. Plastic-laminate cabinets.
4. Plastic-laminate countertops.

B. Related Sections include the following:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-4(d)13 and 16a-38k-4(b)7.
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.
2. Division 06 Section "Interior Finish Carpentry" for interior carpentry exposed to view that is not specified in this Section.
3. Division 12 Section "Simulated Stone Countertops for solid surfacing material countertops.

1.3 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated, including high-pressure decorative laminate, cabinet hardware and accessories and finishing materials and processes.

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
2. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers and other items installed in architectural woodwork.

D. Samples for Initial Selection:

1. Shop-applied transparent finishes.
2. Shop-applied opaque finishes.
3. Plastic laminates.
4. PVC edge material.

E. Samples for Verification:

1. Lumber with or for transparent finish, not less than 5 inches (125 mm) wide by 24 inches (600 mm) long, for each species and cut, finished on 1 side and 1 edge.
2. Lumber and panel products with shop-applied opaque finish, 12 inch long for each finish system and color.
3. Plastic laminates, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish**,** with 1 sample applied to core material and specified edge material applied to 1 edge.
4. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Product Certificates: For each type of product, signed by product manufacturer.

C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide AWI Quality Certification Program certificates indicating that woodwork, including installation, complies with requirements of grades specified.

D. Preinstallation Conference: Conduct conference at Project .

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Species and Cut for Transparent Finish: White Maple, plain sawn or sliced.

C. Wood Species for Opaque Finish: Any closed-grain hardwood.

D. Wood Products: Comply with the following:
1. Hardboard: AHA A135.4.
2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
3. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.

1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:

    a. Formica Corporation.
    b. Nevamar Company, LLC; Decorative Products Div.
    c. Wilsonart International; Div. of Premark International, Inc.

2.2 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, [**100**] [**135**] [**170**] degrees of opening.

C. Back-Mounted Pulls: BHMA A156.9, B02011.

D. Wire Pulls: Back mounted, solid metal, 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter.

E. Catches: Magnetic catches, BHMA A156.9, B03141andRoller catches, BHMA A156.9, B03071, where indicated..

F. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

G. Drawer Slides: BHMA A156.9, B05091.

1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
2. Box Drawer Slides: Grade 1HD-100; for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.
3. File Drawer Slides: Grade 1HD-100; for drawers more than 6 inches (150 mm) high or 24 inches (600 mm) wide.
4. Pencil Drawer Slides: Grade 2; for drawers not more than 3 inches (75 mm) high and 24 inches (600 mm) wide.
5. Keyboard Slides: Grade 1HD-100; for computer keyboard shelves.
6. Trash Bin Slides: Grade 1HD-100; for trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide.

H. Door Locks: BHMA A156.11, E07121.

I. Drawer Locks: BHMA A156.11, E07041.

J. Grommets for Cable Passage through Countertops: 2-inch (51-mm) black, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Product: Subject to compliance with requirements, provide "SG series" by Doug Mockett & Company, Inc.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Stainless Steel: BHMA 630.

L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

M. Flush Mount Aluminum Support Angle

1. Basis-of-Design Product: Subject to compliance with requirements, provide EH Series, Countertop Support Bracket; Rakks/ Rangine Corp.
2. Thickness: 1/4 inch, min.
3. Material: Aluminum.
4. Finish: Clear anodized.
5. Bracket Width: 2 inches min.
6. Size: See drawings for bracket support sizes.

2.3 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

C. Adhesives, General: Adhesives shall not contain urea formaldehyde.

D. Adhesive for Bonding Plastic Laminate: Contact cement .

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.4 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Complete fabrication, including assembly**,** finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

D. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

2.5 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. Grade: Custom.

B. Wood Species: Any closed-grain hardwood.

C. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

D. Field assemble trim in the field.

2.6 WOOD CABINETS FOR TRANSPARENT FINISH

A. Grade: Custom.

B. AWI Type of Cabinet Construction: Flush overlay.

C. Reveal Dimension: 1/2 inch (13 mm).

D. Wood Species and Cut for Exposed Surfaces: White Maple, plain sawn or sliced.

1. Grain Direction: Horizontally for drawer fronts, doors, and fixed panels.
2. Matching of Veneer Leaves: Book match.
3. Vertical Matching of Veneer Leaves: End match.
4. Veneer Matching within Panel Face: Balance match.
5. Veneer Matching within Room: Provide cabinet veneers in each room or other space from a single flitch with doors, drawer fronts, and other surfaces matched in a sequenced set with continuous match where veneers are interrupted perpendicular to the grain.
6. Comply with veneer and other matching requirements indicated for blueprint-matched paneling.

E. Semiexposed Surfaces: Provide surface materials indicated below:

1. Surfaces Other Than Drawer Bodies: Same species and cut indicated for exposed surfaces.
2. Drawer Sides and Backs: Solid-hardwood lumber, stained to match species indicated for exposed surfaces.
3. Drawer Bottoms: Hardwood plywood.

2.7 PLASTIC-LAMINATE CABINETS

A. Grade: Premium.

B. AWI Type of Cabinet Construction: Flush overlay.

C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other Than Tops: Grade HGS.
2. Vertical Surfaces: Grade VGS.
3. Edges: PVC edge banding,0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.

D. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade CLS.

a. Edges of Plastic-Laminate Shelves: PVC edge banding,0.12 inch (3 mm) thick, matching laminate in color, pattern, and finish.

2. Drawer Sides and Backs: Solid-hardwood lumber.
3. Drawer Bottoms: Hardwood plywood.

E. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Basis-of-Design Product: Subject to compliance with requirements, provide 6206-43 Planked Deluxe Pear, Formica Corporation.

F. Provide dust panels of 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

2.8 PLASTIC-LAMINATE COUNTERTOPS

A. Grade: Custom.

B. High-Pressure Decorative Laminate Grade: HGS for flat countertops, HGP for postformed countertops..

C. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Match laminate cabinet color.

D. Edge Treatment: Same as laminate cladding on horizontal surfaces.

E. Core Material: Particleboard or medium-density fiberboard.

F. Core Material at Sinks: Particleboard made with exterior glue or medium-density fiberboard made with exterior glue.

G. Paper Backing: Provide paper backing on underside of countertop substrate.

2.9 CLOSET AND UTILITY SHELVING

A. Grade: Custom.

B. Shelf Material: 3/4-inch (19-mm) medium-density fiberboard with high-pressure decorative laminate Grade (HGS).

Edge Treatment: Same as laminate cladding on horizontal surfaces.

C. Clothes Rods: 1-5/16-inch- (33-mm-) diameter, chrome-plated-steel telescoping tubes with end brackets for mounting on shelf cleats.

2.10 SHOP FINISHING

A. Grade: Provide finishes of same grades as items to be finished.

B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

C. General: Shop finish transparent-finished interior architectural woodwork at fabrication shop as specified in this Section. Refer to Division 09 painting Sections for finishing opaque-finished architectural woodwork.

D. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.

E. Transparent Finish:

1. Grade: Custom.
2. AWI Finish System: Conversion varnish or Catalyzed polyurethane.
3. Staining: Match approved sample for color.
4. Wash Coat for Stained Finish: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
6. Sheen: Satin, 31-45orSemigloss, 46-60 gloss units measured on 60-degree gloss meter per ASTM D 523.

F. Opaque Finish:

1. Grade: Custom.
2. AWI Finish System: Conversion varnish Catalyzed polyurethane.
3. Color: As selected by Architect from manufacturer's full range.

4. Sheen: Satin, 31-45 or Semigloss, 46-60 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nailsfor exposed fastening, countersunk and filled flush with woodwork.

F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 60 inches (1500 mm) long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
   1. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).

G. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

   1. Install cabinets with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
   2. Maintain veneer sequence matching of cabinets with transparent finish.
   3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches (400 mm) o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

H. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
   1. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.

I. Touch up finishing work specified in this Section after installation of woodwork.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 064023

SECTION 07 08 00 – COMMISSIONING OF THERMAL AND MOISTURE PROTECTION

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Notice to Contractor Sections, apply to this Section. Refer to NOTICE TO CONTRACTOR – COMMISSIONING for a full description of the commissioning process and requirements.

1.2. SUMMARY

A. Commissioning consists of systematically documenting that specified components and systems have been installed and started up properly and then functionally tested to verify and document proper operation through all sequences of operation and conditions. In addition, training of the Owner's Operations Personnel will be verified and final project O&M Documents will be reviewed for completeness.

PART 2 – PRODUCTS

2.1. FUNCTIONAL PERFORMANCE TESTING EQUIPMENT AND INSTRUMENTS

A. Contractor shall provide all tools, instruments, laptop computers, PDA's, software programs and services required to perform system Functional Performance Testing procedures. This includes providing the connection to systems to be tested, operation of the test equipment & instrumentation and generating test results as required.

PART 3 – EXECUTION

3.1. FUNCTIONAL PERFORMANCE TESTING

A. The contractor shall demonstrate to the Engineer and the Cx Authority the performance of the following Building Envelope Systems to the performance level identified.

1. Fluid and Crystalline Applied Waterproofing:

a. System/Equipment to be Tested:
   1) Waterproofing membrane at pit perimeter walls
   2) Water proofing membrane on concrete base slabs below component change out shop structure concrete floor slab and below entire building floor slab

b. Functions to be Tested:
   1) Refer to ASTM D 4787 regarding "Holiday Testing"

c. Conditions of the Test:
    1) Refer to ASTM D 4787 regarding “Holiday Testing”

d. Acceptance Criteria:
    1) Refer to Section 07 14 16 – “Fluid Applied Waterproofing” for requirements for Membrane Installation
    2) Refer to Section 07 16 16 – “Crystalline Applied Waterproofing” for requirements for Membrane Installation

2. Fabricated Wall Panel Systems:

a. System/Equipment to be Tested:
    1) Horizontal and vertical wall panel systems, including all insulation, sealants, and gaskets
    2) Fixed aluminum windows and translucent panels within the wall panel system

b. Functions to be Tested:
    1) Refer to AAMA 501.1 regarding “Water Penetration – Dynamic Testing”
    2) Refer to AAMA 501.2 regarding “Water-Spray Test”
    3) Refer to AAMA 508-05 regarding “Pressure Equalization of Horizontal Joinery”
    4) Refer to ASTM E 783 regarding “Air Infiltration”
    5) Refer to ASTM E 331 regarding “Horizontal Panel Joint Performance”

c. Conditions of the Test:
    1) Refer to AAMA 501.1 regarding “Water Penetration – Dynamic Testing”
    2) Refer to AAMA 501.2 regarding “Water-Spray Test”
    3) Refer to AAMA 508-05 regarding “Pressure Equalization of Horizontal Joinery”
    4) Refer to ASTM E 783 regarding “Air Infiltration”
    5) Refer to ASTM E 331 regarding “Horizontal Panel Joint Performance”

d. Acceptance Criteria:
    1) Refer to Section 07 42 63 – “Fabricated Wall Panel System” parts 1.5 and 3.5

3. Roofing:

a. System/Equipment to be Tested:
    1) TPO roofing system over membrane underlayment and plywood sheathing

b. Functions to be Tested:
    1) Refer to ASTM E 1646
    2) Refer to ASTM E 1680

c. Conditions of the Test:
    1) Refer to ASTM E 1646
    2) Refer to ASTM E 1680

d. Acceptance Criteria:
    1) Refer to Section 07 61 00 – “Sheet Metal Roofing” part 1.5

END OF SECTION 07 08 00

SECTION 071416 - COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Polyurethane waterproofing.
2. Insulation drainage panels.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4.
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 093000 "Tiling" for fluid-applied waterproof membranes beneath ceramic tiles.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review waterproofing requirements including, but not limited to, the following:

   a. Surface preparation specified in other Sections.
   b. Minimum curing period.
   c. Forecasted weather conditions.
   d. Special details and sheet flashings.
   e. Repairs.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

C. Shop Drawings:

1. Show locations and extent of waterproofing.
2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

D. Samples: For each exposed product and for each color and texture specified, including the following products:

1. Flashing sheet, 8 by 8 inches (200 by 200 mm).
2. Membrane-reinforcing fabric, 8 by 8 inches (200 by 200 mm).
3. Insulation, 8 by 8 inches (200 by 200 mm).
4. Drainage panel, 4 by 4 inches (100 by 100 mm).

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE SUBMITTALS

A. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.7 CLOSEOUT SUBMITTALS

Warranty: For Cold Fluid-Applied Waterproofing specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.

1. Build mockup for each typical waterproofing installation including accessories to demonstrate surface preparation, crack and joint treatments, inside and outside corner treatments, and protection.

a. Size: 100 sq. ft. (9.3 sq. m) in area.
b. Description: Each type of wall installation.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer.

1. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.
2. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.10 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace waterproofing that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.

1. Warranty includes removing and reinstalling protection board, drainage panels and insulation.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations for Waterproofing System: Obtain waterproofing materials**,** protection course, and molded-sheet drainage panels from single source from single manufacturer.

2.2 SINGLE-COMPONENT POLYURETHANE WATERPROOFING

A. Single-Component, Modified Polyurethane Waterproofing: ASTM C 836/C 836M and coal-tar free.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Construction Chemicals, LLC, Building Systems; Sonoshield HLM 5000.
b. Carlisle Coatings & Waterproofing Inc; CCW-525-V.
c. Tremco Incorporated; Tremproof 201/60.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials recommended in writing by waterproofing manufacturer for intended use and compatible with one another and with waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Manufacturer's standard primer, sealer, or surface conditioner; factory-formulated acrylic latex, polyurethane, or epoxy.

C. Sheet Flashing: 50-mil- (1.3-mm-) minimum, nonstaining, uncured sheet neoprene.

1. Adhesive: Manufacturer's recommended contact adhesive.

D. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.

E. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing; ASTM C 920, Type M, Class 25 or greater; Grade NS for sloping and vertical applications and Grade P for deck applications; Use NT exposure and as recommended by manufacturer for substrate and joint conditions.

1. Backer Rod: Closed-cell polyethylene foam.

2.4 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Composite subsurface drainage panel consisting of a studded, nonbiodegradable, molded-plastic-sheet drainage core; with a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to one side of the core and a polymeric film bonded to the other side; and with a vertical flow rate of 9 to 18 gpm per ft. (112 to 220 L/min. per m).

1. Products: Subject to compliance with requirements, provide one of the following:

a. American Hydrotech, Inc; Hydrodrain 400.
b. Carlisle Coatings & Waterproofing; CCW MiraDRAIN 6200.
c. Grace Construction Products; W.R. Grace & Co. -- Conn; Hydroduct 220.

2.5 INSULATION DRAINAGE PANELS

A. Insulation Drainage Panels, General: Comply with Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

3.3 PREPARATION AT TERMINATIONS, PENETRATIONS, AND CORNERS

A. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 1471.

B. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrate according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 1471. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Comply with ASTM C 1193 for joint-sealant installation.
2. Apply bond breaker on sealant surface, beneath preparation strip.

3. Prime substrate along each side of joint and apply a single thickness of preparation strip at least 6 inches (150 mm) wide along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.

B. Install sheet flashing and bond to wall substrates where required according to waterproofing manufacturer's written instructions.

1. Extend sheet flashings for a minimum of 4 inches (100 mm) onto perpendicular surfaces and items penetrating substrate.

3.5 WATERPROOFING APPLICATION

A. Apply waterproofing according to manufacturer's written instructions and to recommendations in ASTM C 1471.

B. Start installing waterproofing in presence of manufacturer's technical representative.

C. Apply primer over prepared substrate unless otherwise instructed in writing by waterproofing manufacturer.

D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.

1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases and pinholes, with a dry film thickness of 60 mils (1.5 mm).
2. Apply waterproofing to prepared wall terminations and vertical surfaces.
3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft. (9.3 sq. m).

E. Cure waterproofing, taking care to prevent contamination and damage during application and curing.

3.6 INSULATION DRAINAGE PANEL INSTALLATION

A. Install drainage panels over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.

B. Ensure that drainage channels are aligned and free of obstructions.

C. On vertical surfaces, set insulation drainage panels in adhesive or tape applied according to manufacturer's written instructions.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections:

1. Testing agency shall verify thickness of waterproofing during application for each 600 sq. ft. (56 sq. m) of installed waterproofing or part thereof.

B. Manufacturer's Field Service: Engage a full-time site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components and to furnish daily reports to Architect.

C. If test results or inspections show waterproofing does not comply with requirements, remove and replace or repair the waterproofing as recommended in writing by manufacturer, and make further repairs after retesting and inspecting until waterproofing installation passes.

D. Prepare test and inspection reports.

3.8 PROTECTION

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071416

SECTION 071616 - CRYSTALLINE WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes crystalline waterproofing for positive-side application to concrete elevator pits.

B. Related Sections:

1. Section 033000 "Cast-in-Place Concrete" for finishing concrete walls and slabs to receive waterproofing.
2. Section 079200 "Joint Sealants" for elastomeric sealants in concrete walls and floors.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include material descriptions and installation instructions for crystalline waterproofing.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Applicator.

B. Product Certificates: For waterproofing, patching, and plugging materials, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for crystalline waterproofing.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE SUBMITTALS

A. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.6 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying crystalline waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and that employs workers trained and approved by manufacturer.

B. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit crystalline waterproofing to be performed according to manufacturer's written instructions.

B. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.

C. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40 deg F (4.4 deg C) or above during work and cure period, and space is well ventilated and kept free of water.

PART 2 - PRODUCTS

2.1 WATERPROOFING MATERIALS

A. Crystalline Waterproofing: Prepackaged, gray-colored proprietary blend of portland cement, specially treated sand, and active chemicals that, when mixed with water and applied, penetrates into concrete and concrete unit masonry and reacts chemically with the byproducts of cement hydration in the presence of water to develop crystalline growth within substrate capillaries to produce an impervious, dense, waterproof substrate; that has VOC content complying with limits of authorities having jurisdiction; with properties meeting or exceeding the criteria specified below.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Euclid Tamms; HEY'DI K-11
   b. Kryton Group of Companies (The); Krystol T1 & T2 Waterproofing System.
   c. Xypex Chemical Corporation; Xypex.

2. Water Permeability: Maximum zero for water at 30 feet (9 m) when tested according to CE CRD-C 48.
3. Compressive Strength: Minimum 4000 psi (27.6 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.2 ACCESSORY MATERIALS

A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections; compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.

B. Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.

C. Portland Cement: ASTM C 150, Type I.

D. Sand: ASTM C 144.

E. Polymer Admixture for Protective Topping: Polymer bonding agent and admixture designed to improve adhesion to prepared substrates and not to create a vapor barrier.

F. Water: Potable.

2.3 MIXES

A. Crystalline Waterproofing: Add prepackaged dry ingredients to water according to manufacturer's written instructions. Mix together with mechanical mixer or by hand to required consistency.

B. Protective Topping: Measure, batch, and mix portland cement and sand in the proportion of 1:3 and water gaged with a polymer admixture. Blend together with mechanical mixer to required consistency.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for suitable conditions where waterproofing is to be applied.

B. Proceed with application only after unsatisfactory conditions have been corrected.

C. Notify Architect in writing of active leaks or defects that would affect system performance.

3.2 PREPARATION

A. Protect other work from damage caused by cleaning, preparation, and application of waterproofing. Provide temporary enclosure to confine spraying operation and to ensure adequate ambient temperatures and ventilation conditions for application.

B. Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves.

C. Stop active water leaks with plugging compound according to waterproofing manufacturer's written instructions.

D. Repair damaged or unsatisfactory substrate with patching compound according to manufacturer's written instructions.

1. At holes and cracks in substrate, remove loosened chips and cut reveal with sides perpendicular to surface, not tapered, and approximately 1 inch (25.4 mm) deep. Fill reveal with patching compound flush with surface.

E. Surface Preparation: Comply with waterproofing manufacturer's written instructions to remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to surfaces.

1. Clean concrete surfaces according to ASTM D 4258.

a. Scratch- and Float-Finished Concrete: Etch with 10 percent muriatic (hydrochloric) acid solution according to ASTM D 4260.
b. Prepare smooth-formed and trowel-finished concrete by mechanical abrading or abrasive-blast cleaning according to ASTM D 4259.

2. Concrete Joints: Clean reveals according to waterproofing manufacturer's written instructions.

3.3 APPLICATION

A. General: Comply with waterproofing manufacturer's written instructions for application and curing.

1. Saturate surface with water for several hours prior to application and maintain damp condition until applying waterproofing. Remove standing water.
2. Apply waterproofing to elevator pits.
3. Number of Coats: Number required for specified water permeability.
4. Application Method: Apply to ensure that each coat fills voids and is in full contact with substrate or previous coat.
5. Dampen surface between coats.

B. Final Coat Finish: Spray Textured.

C. Curing: Moist-cure waterproofing for three days immediately after final coat has set, followed by air drying, unless otherwise recommended in writing by manufacturer.

D. Protective Topping: Apply 1-inch- (25.4-mm-) thick, protective topping over floor surfaces.

3.4 FIELD QUALITY CONTROL

A. Inspection: Engage manufacturer's representative to inspect completed application and provide a written report that application complies with manufacturer's written instructions.

END OF SECTION 071616

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Foam-plastic board insulation.
2. Glass-fiber blanket insulation.
3. Spray polyurethane foam insulation.
4. Aerogel Insulation Blanket

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4, 16a-38k-4(d)9 and 16a-38k-4(b)7.
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 071416 "Cold Fluid-Applied Waterproofing" for insulated drainage panels installed with waterproofing.
3. Section 072713 "Modified Bituminous Sheet Air Barriers" for transitional air barrier components that provide continuity of the air barrier.
4. Section 075423 "Thermoplastic Polyolefin (TPO) Roofing" for insulation specified as part of roofing construction.
5. Section 078446 "Fire-Resistive Joint Systems" for insulation installed as part of a perimeter fire-resistive joint system.
6. Section 092900 “Gypsum Board” for installation in metal-framed assemblies of insulation specified by referencing this Section.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

B. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 QUALITY ASSURANCE SUBMITTALS

Deleted: AU

A. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.6 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Aerogel Insulation: Installers should have prior experience with aerogel blanket handling and installation or have proper training on the material usage and handling.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 25 and 75, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. DiversiFoam Products.
b. Dow Chemical Company (The).
c. Owens Corning.

2. Below Grade Insulation: Type VI, 40 psi (276 kPa).
3. Under Slab Insulation: Type V, 100 psi (690 kPa).
4. Aged R-Value: 5 per inch thickness.

B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

2.2 GLASS-FIBER BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CertainTeed Corporation.
2. Knauf Insulation.
3. Owens Corning.

B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

C. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:

1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.3 SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Polyurethane Spray Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. BASF Corporation.
b. Dow Chemical Company (The).
c. Henry Company.

2. Minimum density of 1.5 lb/cu. ft. (24 kg/cu. m), thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F (43 K x m/W at 24 deg C).

a. Aged R-Value: 6.7 per inch thickness.

3. Maximum Thickness: As indicated on the drawings.

B. Open-Cell Polyurethane Spray Foam Insulation: Spray-applied polyurethane foam using water as a blowing agent, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. BaySystems NorthAmerica, LLC.
   b. Gaco Western Inc.
   c. Icynene Inc.

2. Minimum density of 0.4 lb/cu. ft. (6.4 kg/cu. m), thermal resistivity of 3.4 deg F x h x sq. ft./Btu x in. at 75 deg F (24 K x m/W at 24 deg C).

   a. Aged R-Value: 3.7 per inch thickness.

3. Maximum Thickness: As indicated on the drawings.

2.4 AEROGEL INSULATION BLANKET

A. Thin, flexible, fire resistant, compression resistant, hydrophobic, vapor permeable, silicon aerogel insulation.

1. Basis-of-Design Product: Subject to compliance with requirements, provide HPI-1000; Dow Corning Corporation.

B. Performance Criteria:

1. Flexible silicon aerogel blanket.
2. Comply with ASTM C1728, Type I, Group 1, Category B.
3. Thermal resistance: R values of 9.0/in minimum per ASTM C518 tested at 75°F mean temperature.
4. Hydrophobicity: 8% by weight maximum per ASTM C1511.
5. Fire resistance: ASTM E84 Class A minimum, flame spread 25 max, smoke developed 50 max
6. Permeance per ASTM E96: 1500 ng/Pa-m^2-s (26 US Perms) minimum.

C. Accessories:

1. Mechanical fasteners in accordance with manufactures written recommendations.
2. Adhesive in accordance with manufactures written recommendations.

D. Sustainability Requirements: Provide aerogel insulation blanket as follows:

1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation or air barriers, including removing projections capable of puncturing air barriers, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

A. On vertical surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 48 inches (1220 mm) below exterior grade line.

3.4 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Glass-Fiber : Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically.

C. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

D. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
   1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.5 INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES

A. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

   1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
   2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
   3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
   4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.6 INSTALLATION OF AEROGEL INSULATION

A. Install insulation in accordance with manufacturer’s written recommendations.

B. Examination:
   1. Surfaces to attach insulation should be conditioned appropriately.
   2. For mechanically attached installation, surfaces should be examined for protrusions and anchor points so that the insulation can form tightly to the insulated surface.
   3. For adhesivively attached installation, the bonding surface should be free of protrusions, dust, debris, an moisture.

3.7 PROTECTION

A. Protect installed insulationfrom damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072713 - MODIFIED BITUMINOUS SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes self-adhering, vapor-retarding, modified bituminous sheet air barriers.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credit 16a-38k-4(b)4.
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

1.3 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.

C. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
2. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with air barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.3 SELF-ADHERING SHEET AIR BARRIER

A. Modified Bituminous Sheet: 40-mil- (1.0-mm-) thick, self-adhering sheet consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick, cross-laminated polyethylene film with release liner on adhesive side and formulated for application with primer that complies with VOC limits of authorities having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Carlisle Coatings & Waterproofing Inc.; CCW-705.
b. Grace, W. R. & Co. - Conn.; Perm-A-Barrier Wall Membrane.
c. Henry Company; Blueskin VP 100.

2. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E 2178.
b. Tensile Strength: Minimum 250 psi (1.7 MPa); ASTM D 412, Die C.
c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.
d. Puncture Resistance: Minimum 40 lbf (180 N); ASTM E 154.
e. Water Absorption: Maximum 0.15 percent weight gain after 48-hour immersion at 70 deg F (21 deg C); ASTM D 570.
f. Vapor Permeance: Maximum 0.05 perm (2.9 ng/Pa x s x sq. m); ASTM E 96/E 96M, Water Method.

2.4 ACCESSORY MATERIALS

A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier membrane.

B. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.

C. Counterflashing Strip: Modified bituminous 40-mil- (1.0-mm-) thick, self-adhering sheet consisting of 32 mils (0.8 mm) of rubberized asphalt laminated to an 8-mil- (0.2-mm-) thick, cross-laminated polyethylene film with release liner backing.

D. Butyl Strip: Vapor retarding, 30 to 40 mils (0.76 to 1.0 mm) thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive, with release liner backing.

E. Modified Bituminous Strip: Vapor retarding, 40 mils (1.0 mm) thick, smooth surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick, cross-laminated polyethylene film with release liner backing.

F. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

G. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

H. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

I. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, 1.5- to 2.0-lb/cu. ft. (24- to 32-kg/cu. m) density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

J. Modified Bituminous Transition Strip: Vapor retarding, 40 mils (1.0 mm) thick, smooth surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick polyethylene film with release liner backing.

K. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that concrete has cured and aged for minimum time period recommended by air-barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify that masonry joints are flush and completely filled with mortar.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

   1. Install modified bituminous strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch (1.6 mm).

G. Bridge and cover isolation joints, expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with overlapping modified bituminous strips.

H. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

I. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 INSTALLATION

A. General: Install modified bituminous sheets and accessory materials according to air-barrier manufacturer's written instructions and according to recommendations in ASTM D 6135.

   1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous air-barrier sheet produced for low-temperature application. Do not install low-temperature sheet if ambient or substrate temperature is higher than 60 deg F (16 deg C).

B. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.

   1. Install modified bituminous strips centered over vertical inside corners. Install 3/4-inch (19-mm) fillets of termination mastic on horizontal inside corners.

C. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations with termination mastic and according to ASTM D 6135.

D. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

E. Apply continuous modified bituminous sheets over modified bituminous strips bridging substrate cracks, construction, and contraction joints.

F. CMU: Align top edge of air-barrier sheet immediately below protruding masonry ties or joint reinforcement or ties, and firmly adhere in place.
1. Apply overlapping sheets with bottom edge slit to fit around masonry reinforcing or ties. Roll firmly into place.
2. Seal around masonry reinforcing or ties and penetrations with termination mastic.
3. Continue the membrane into all openings in the wall, such as doors and windows, and terminate at points to maintain an airtight barrier that is not visible from interior.

G. Seal top of through-wall flashings to air-barrier sheet with an additional 6-inch- (150-mm-) wide, modified bituminous strip for non-metallic flashing and/or metal through wall counterflashing strip, as required.

H. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

I. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.

1. Coordinate air-barrier installation with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install butyl strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.

J. Connect and seal exterior wall air-barrier membrane continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

K. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply modified bituminous transition strip so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames with not less than 1 inch (25 mm) of full contact.

1. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.

L. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of air-barrier membrane with foam sealant.

M. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.

N. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

O. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches (150 mm) beyond repaired areas in all directions.

P. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.4 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 30 days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed Work, using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 072713

SECTION 074213 - METAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Engineered Rainscreen Façade System Assembly.

a. Steel faced, polyisocyanurate insulated metal wall panels used an insulated barrier wall.
b. Barrier wall support rail..
c. Aluminum plate, back routed exposed fastener wall panels used as a rainscreen.
d. Accessories including hat channels, fasteners, blocking, flashings and perimeter trim.

2. Steel faced, polyisocyanurate insulated metal wall panels used an insulated barrier wall.
3. Translucent wall panels (non-rainscreen).
4. Accessories including hat channels, fasteners, flashings and perimeter trim (non-rainscreen).

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-4(d)9 and 16a-38k-4(b)7.

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 054000 "Cold-Formed Metal Framing" for support framing not provided by metal wall panel system manufacturer.
3. Section 076200 "Sheet Metal Flashing and Trim" for flashing and other sheet metal work that is not part of metal wall panel assemblies.

1.3 DEFINITION

A. Metal Wall Panel Assembly: Metal wall panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight wall system.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Metal wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Design metal wall panel and translucent wall panel assemblies, including comprehensive engineering analysis by a qualified professional engineer, licensed in the State of Connecticut, using performance requirements and design criteria indicated.

C. Metal Wall Panels:

1. Air Infiltration: Air leakage through assembly of not more than 0.001 cfm/sq. ft. of wall area when tested according to ASTM E 283 at the following test-pressure difference:

a. Test-Pressure Difference: 20 lbf/sq. ft. (75 Pa).

2. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

a. Test-Pressure Difference: 20 lbf/sq. ft. (300 Pa).

3. Water Penetration under Dynamic Pressure: No evidence of water leakage when tested according to AAMA 501.1 under dynamic pressure difference of 12 lbf/sq. ft. (575 Pa).

a. Water Leakage: As defined according to AAMA 501.1.

4. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:

a. Wind Loads: As indicated on Structural Drawings.
b. Other Design Loads:

1) Lateral Pressures:

a) Field: 26.3 psf inward pressure, 28.5 psf outward pressure.
b) Corner: 26.3 psf inward pressure, 35.1 psf outward pressure.

c. Deflection Limits: Metal wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/180 of the span.

5. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

a. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

6. FM Global (FM):

a. Approval Standard 4880; Class 1 Fire Rating of Insulated Wall or Wall and Roof/Ceiling Panels, Interior Finish Materials or Coatings, and Exterior Wall Systems.
b. Approval Standard 4881; Class 1 Exterior Wall Systems.

7. Flame Spread and Smoke Developed Tests on exposed Insulating Core:

   a. Flame Spread: Less than 25.
   b. Smoke Developed: Less than 250.
   c. Tests performed in accordance with ASTM E84.

8. Fire Test Response Characteristics: Steel-faced panels with polyisocyanurate (ISO) core shall fully comply with Chapter 26 of International Building Code regarding the use of Foam Plastic.

   a. FM 4880: Class I rated per FM Global, panels are approved for use without a thermal barrier and do not create a requirement for automatic sprinkler protection.

   b. NFPA 285 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load Bearing wall Assemblies Containing Combustible Components: Intermediate scale multi-story fire evaluation, successfully passed acceptance criteria.

9. Insulating Core: Polyisocyanurate (ISO) core, ASTM C591 Type IV, CFC and HCFC free, with the following minimum physical properties:

   a. Core is 90 percent closed cell when tested in accordance with ASTM D6226
   b. Panel shall provide a nominal R-value of 7.5 per inch thickness when tested in accordance with ASTM C518 at a mean temperature of 75 deg. F.
   c. Foam has a density of 2.2 to 2.8 pounds per cubic foot when tested in accordance with ASTM D1622
   d. Compressive Stress:

      1) Parallel to Rise: 42 psi
      2) Perpendicular to Rise: 24 psi
      3) Tested in accordance to ASTM D1621

   e. Shear Stress: 17.5 psi when tested in accordance with ASTM C273
   f. Tensile Stress: 25 psi when tested in accordance with ASTM D1623
   g. Oven Aging at 200 degrees F:

      1) 1 day: plus 1 percent volume change
      2) 7 days: plus 3 percent volume change
      3) Tested according to ASTM D2126

   h. Low Temperature Aging at minus 20 degrees F:

      4) 1 day: 0 percent volume change
      5) 7 days: 0 percent volume change
      6) Tested according to ASTM D212.

D. Translucent Wall Panels:

1. Air Infiltration: Air leakage through assembly of not more than 0.05 cfm/sq. ft. of wall area when tested according to ASTM E 283 at the following test-pressure difference:

   a. Test- Pressure Difference: 1.57 lbf/sq. ft. and not to exceed .07 cfm/sq. ft. when tested at 6.24 lbf/sq. ft.

2. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

   a. Test -Pressure Difference: 7.5 lbf/sq. ft.

3. Air Pressure Difference: No damage at 75 PSF, when tested per ASTM E330.

4. Structural Performance: Provide translucent wall panel assemblies capable of withstanding the effects the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:

   a. Wind Loads: As indicated on Structural Drawings.
   b. Other Design Loads:

      1) Lateral Pressures:

         a) Field: 26.3 psf inward pressure, 28.5 psf outward pressure.
         b) Corner: 26.3 psf inward pressure, 35.1 psf outward pressure.

   c. Deflection Limits: Metal wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/100 of the span.

5. Flame Spread and Smoke Developed Tests on exposed Insulating Core:

   a. Flame Spread: ASTM E 84, Class A.
   b. Smoke Developed: ASTM D 635, CC1.
   c. Smoke Density: ASTM E 84, Class A.
   d. Ignition Temperature: ASTM D1929.
   e. Density of Smoke: ASTM D 2843.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of wall panel and accessory.

C. Shop Drawings: Show fabrication and installation layouts of metal wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory-, shop- and field-assembled work.

1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches (1:10):

    a. Flashing and trim.
    b. Anchorage systems.

D. Samples for Initial Selection: For each type of metal wall panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.
2. Include manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each sealant exposed to view.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal wall panel accessories.
2. Trim and Closures: 12 inches (305 mm) long. Include fasteners and other exposed accessories.
3. Accessories: 12 inch (305 mm) long samples for each type of accessory.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Exterior elevations drawn to scale and coordination penetrations and wall- mounted items. Show the following:

1. Wall panels and attachments.
2. Sub-framing provided by metal panel system manufacturer.
3. Girts and Stud framing not provided by the metal panel system manufacturer.
4. Wall-mounted items including doors, windows, louvers, and lighting fixtures.
5. Penetrations of wall by pipes and utilities.

B. Qualification Data: For Installer, professional engineer and testing agency.

C. Material Certificates: For thermal insulation, signed by manufacturers.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

E. Field quality-control reports.

F. Warranties: Sample of special warranties.

1.7 QUALITY ASSURANCE SUBMITTALS

A. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Metal Wall Panels to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

B. Warranty: For Metal Wall Panels specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

C. Source Limitations: Obtain each type of metal wall panel from single source from single manufacturer.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall and corner panel, including soffit, as shown on Drawings; approximately one bay wide by one story high by full thickness, including insulation, supports, attachments, and accessories.
2. Conduct water spray test of mockup of metal wall panel assembly, testing for water penetration according to AAMA 501.2.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal wall panel Installer, metal wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal wall panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal wall panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal wall panel assembly during and after installation.

8. Review wall panel observation and repair procedures after metal wall panel installation.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal wall panels, and other manufactured items so as not to be damaged or deformed. Package metal wall panels for protection during transportation and handling.

B. Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal wall panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Remove protective film immediately after installation of insulated barrier wall panels and aluminum plate rainscreen panels.

E. Protect foam-plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.11 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal wall panels to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal wall panel fabrication, and indicate measurements on Shop Drawings.

1.12 COORDINATION

A. Coordinate metal wall panel assemblies with rain drainage work, flashing, trim, and construction of girts, studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.13 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 10 years from date of Substantial Completion.

C. Weather Tightness Warranty: For engineered rainscreen façade system assembly.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL MATERIALS

A. Metallic-Coated Steel Sheet: Restricted flatness steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40 (Class AZM150 coating designation, Grade 275); structural quality.
2. Surface: Embossed finish.
3. Exposed Coil-Coated Finish:

a. 2- Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
b. Siliconized-Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil (0.005 mm) for primer and 0.8 mil (0.02 mm) for topcoat.

4. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

B. Aluminum Sheet: Coil-coated sheet, ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

1. Surface: Smooth, flat finish.
2. Exposed Coil-Coated Finish:

a. 2-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

C. Panel Sealants:

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal wall panels and remain weathertight; and as recommended in writing by metal wall panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

D. Spray Foam: Manufacturers standard two-part urethane.

2.2 MISCELLANEOUS METAL FRAMING

A. Subgirts: Manufacturer's standard C- or Z-shaped sections, min. 0.064-inch (1.63-mm) nominal thickness.

B. Barrier Wall Support Rails (rainscreen): Manufacturers Standard, ASTM A653 cold formed, G90 hot-dip galvanized, painted gray.

C. Zee Clips: Min. 0.079-inch (2.01-mm) nominal thickness.

D. Base or Sill Angles and/or Channels: min. 0.079-inch (2.01-mm) nominal thickness.

E. Hat-Shaped, Rigid Furring Channels:

1. Nominal Thickness: As required to meet performance requirements, min. 0.040 inch (1.02 mm) thickness.
2. Depth: As indicated on drawings.

F. Cold-Rolled Furring Channels: Minimum 1/2-inch- (13-mm-) wide flange.

1. Nominal Thickness: As required to meet performance requirements, min. 0.064 inch (1.63 mm) thickness.
2. Depth: As indicated on drawings.
3. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with min. 0.040-inch (1.02-mm) nominal thickness.
4. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.57-mm-) diameter wire, or double strand of 0.048-inch- (1.22-mm-) diameter wire.

G. Z-Shaped Furring: With slotted or nonslotted web, face flange of min. 1-1/4 inches (32 mm), wall attachment flange of min. 7/8 inch (22 mm), and depth as indicated.

1. Nominal Thickness: As required to meet performance requirements, min. 0.025 inch (0.64 mm).

H. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

2.3 MISCELLANEOUS MATERIALS

A. Panel Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

2.4 STEEL FACED, POLYISOCYANURATE INSULATED METAL WALL PANELS USED AN INSULATED BARRIER WALL

A. General: Provide factory-formed metal wall panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and clips in side laps. Include accessories required for weathertight installation.

B. Steel Faced, Polyisocyanurate Iinsulated Metal Wall Panels used an Insulated Barrier Wall: Formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with narrow reveal joint between panels.

1. Basis-of-Design Product: Subject to compliance with requirements, provide KS36MR; Kingspan Insulated Panels, Inc.

2. Material: Aluminum-zinc alloy-coated steel sheet, 24 guage nominal thickness, exterior face.

a. Exterior Finish: 2- Coat Fluoropolymer.
b. Exterior Profile: Equal to Micro-Rib, Kingspan Insulated Panels, Inc.
c. Interior Profile: Equal to Shadowline, Kingspan Insulated Panels, Inc.
d. Exterior and Interior Texture: Non-directional, stucco embossed.

e. Basis-of-Design Interior Color: Imperial white, Kingspan Insulated Panels, Inc.
f. Basis-of-Design Exterior Color: Varying. Each panel will be one of the following colors.

1) “Silver Quill” #A1941, Glidden; 36” vertical insulated metal wall panels.
2) “Frost Grey” #A1942, Glidden; 36” vertical insulated metal wall panels.
3) “West Coast Grey” A1943, Glidden; 36” vertical insulated metal wall panels.

3. Panel Width: 36 inches (915 mm).
4. Panel Length (height): Full height continuous.
5. Panel Thickness: 2 inches and 3 inches.
6. Panel Orientation: Vertical
7. Corners: Factory formed caps, continuous miter.
8. Vertical Panel Joint Reveal: 1/8 inch.

2.5 ENGINEERED RAINSCREEN FAÇADE SYSTEM ASSEMBLY

A. General: Provide factory-formed metal wall panels designed to be field assembled by lapping and interconnecting top and bottom edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and clips in top and bottom laps. Include accessories required for weathertight installation.

B. Steel Faced, PolyisocyanurateInsulated Metal Wall Panels used an Insulated Barrier Wall. : Formed with horizontal and vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with narrow reveal joint between panels.

1. Basis-of-Design Product: Subject to compliance with requirements, provide KS42MR; Benchmark by Kingspan Engineered Façade System Assembly.

2. Material: Aluminum-zinc alloy-coated steel sheet, 26 guage nominal thickness, exterior and interior face of panel.

a. Exterior Finish: Siliconized polyester.
b. Basis-of-Design Exterior and Interior Profile: Shadowline, Benchmark by Kingspan.
c. Exterior and Interior Texture: Non-directional, stucco embossed.
d. Basis-of-Design Exterior Color: Gray, Benchmark by Kingspan.
e. Basis-of-Design Interior Color: Imperial white, Benchmark by Kingspan.
f. Basis-of-Design Color for Exposed framing used to support rainscreen railings: Gray, Benchmark by Kingspan..

3. Panel Width: 42 inches (1068 mm).
4. Panel Length: 20 feet.
5. Panel Thickness: 2 inches.
6. Panel Orientation: Horizontal.
7. Horizontal Panel Joint Reveal: 3/8 inch.
8. Vertical Panel Joint Reveal: 1/2 inch field formed.

C. Aluminum Plate, Exposed Fastener Wall Panels used as a Rainscreen.: Aluminum plate, back routed formed box with neoprene vertical stiffening spacers at fasteners. Panels are spaced to provide air gap between panels.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Benchmark by Kingspan Engineered Façade System Assembly.

   a. Material: Aluminum sheet, 1/8” (.125”) inch (3-mm) nominal thickness.

   b. Exterior Finish: 2-Coat Fluoropolymer.

2. Panel Width: 5-1/2 inches.
3. Panel Length: Random. 4 feet min., 20 feet max.
4. Panel Returns/Thickness: 3/4 inches. Returns required on all four sides of each panel.
5. Panel Orientation: Horizontal.
6. Corners: Single piece, continuous formed.
7. Horizontal and Vertical Panel Joint Reveal: 1/2 inch.
8. Joint Spacing: Random running bond.
9. Basis-of-Design Colors:

   a. Greens:

      1) “Summers Carpet” #A1020, Glidden; 5.5” horizontal aluminum plate rain screen.
      2) “Royal Garden” #A1021, Glidden; 5.5” horizontal aluminum plate rain screen.
      3) “Southern Pine” #A1022, Glidden; 5.5” horizontal aluminum plate rain screen.

   b. Blues:

      1) “Middy Blue” #A1258, Glidden; 5.5” horizontal aluminum plate rain screen.
      2) “Narragansett” #A1259, Glidden; 5.5” horizontal aluminum plate rain screen.
      3) “Artic Pool” #A1260, Glidden; 5.5” horizontal aluminum plate rain screen.

   c. All rainscreen railing support framing shall be factory painted gray.
   d. See drawings for primary and secondary girt locations.

2.6 TRANSLUCENT WALL PANEL (NON RAINSCREEN)

A. Base plate, pressure plate and cap system glazed with polycarbonate structured sheet. Glass fiber reinforced thermoset resin (fiberglass) faces and double glazed systems are not acceptable.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Series 3500 Duo-Gard Industries Inc.

B. Polycarbonate Structured Sheet:

1. Sheet Thickness: 40mm.
2. Sheet Width: 19.7 inches.
3. Profile: Tongue and groove with aluminum adaptor extrusions.
4. U-Value: 0.29, per NFRC 100(for entire system, no center of glazing numbers shall be accepted).
5. Light Transmittance: Visible transmittance at normal incidence of 27% opal and 49% clear.
6. UV Stabilization: Coextruded into panels, not cleared.
7. Resist Yellowing: Maximum 10 delta for a minimum of 15 years.
8. Sheet Appearance: Uniform in color.
9. Expansion and Contraction: Design and install components with provisions for expansion and contraction due to a 120 degree F temperature variation.
10. Gaskets and Dry Seals: TPV.
11. Color: As selected by Architect from manufacturer's full range

C. Structural Framing System:

1. Framing System: Aluminum alloy 6063 T5.
2. Combined maximum deflection: 1 inch

D. Special Testing"

1. Polycarbonate Panel supplier shall provide a Daylight Autonomy study that show a minimum compliance percentage of 55% coverage of the main Bus storage area and mechanics garage bays for 25 foot candles over a horizontal analysis grid 2'-6" off the floor and show a mean illuminance of 500 lux in those areas on the autumnal equinox at noon.

2.7 ACCESSORIES

A. Wall Panel Accessories(insulated metal wall panel): Provide components required for a complete metal wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal wall panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction
4. Translucent wall panel aluminum adapter extrusion furnished by insulated metal wall panel manufacturer installed by translucent wall panel contractor.

B. Flashing and Trim: Formed from 0.018-inch (0.46-mm) minimum thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished

appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal wall panels.

2.8 FABRICATION

A. General: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal wall panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, and that will minimize noise from movements within panel assembly.

E. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal wall panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.9 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
3. Verify that weather-resistant sheathing paper has been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
4. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorages according to ASTM C 754 and metal wall panel manufacturer's written recommendations.

1. Soffit Framing: Clip furring channels to supports, as required to comply with requirements for assemblies indicated.

3.3 THERMAL INSULATION INSTALLATION

A. Board Insulation: Extend insulation in thickness indicated to cover entire wall. Comply with installation requirements in Section 072100 "Thermal Insulation."

1. Erect insulation horizontally and hold in place with Z-shaped furring members spaced 24 inches (610 mm) o.c.. Attach furring members to substrate with screws spaced 24 inches (610 mm) o.c.
2. Retain insulation in place by metal clips and straps or integral pockets within panels, spaced at intervals according to insulation manufacturer's instructions. Maintain cavity width between insulation and metal liner panel of dimension indicated.

3.4 METAL WALL PANEL INSTALLATION

A. General: Install metal wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Commence metal wall panel installation and install minimum of 300 sq. ft. (27.8 sq. m.) in presence of factory-authorized representative.
2. Shim or otherwise plumb substrates receiving metal wall panels.
3. Flash and seal metal wall panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until weather barrier and flashings that will be concealed by metal wall panels are installed.
4. Install screw fasteners in predrilled holes.
5. Locate and space fastenings in uniform vertical and horizontal alignment.
6. Install flashing and trim as metal wall panel work proceeds.
7. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
8. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
9. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
10. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.

B. Fasteners:

1. Steel Wall Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal wall panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.

1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

E. Zee Clips: Provide Zee clips of size indicated or, if not indicated, as required to act as standoff from subgirts for thickness of insulation indicated. Attach to subgirts with fasteners.

3.5 METAL SOFFIT PANEL INSTALLATION

A. In addition to complying with requirements of "Metal Wall Panel Installation, General" Article, install metal soffit panels to comply with the requirements of this article.

B. Metal Soffit Panels: Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.

1. Flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of all openings.

3.6 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Water Penetration: Test areas of installed system indicated on Drawings for compliance with system performance requirements according to ASTM E 1105 at minimum differential pressure of 20 percent of inward-acting, wind-load design pressure as defined by SEI/ASCE 7, but not less than 6.24 lbf/sq. ft. (300 Pa).

C. Water-Spray Test: After completing the installation of 75-foot- (23-m-) by-2-story minimum area of metal wall panel assembly, test assembly for water penetration according to AAMA 501.2 in a 2-bay area directed by Architect.

D. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect and test completed metal wall panel installation, including accessories.

E. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.

F. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in a clean condition during construction.

B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213

SECTION 075423 - THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Adhered thermoplastic polyolefin (TPO) roofing system.
2. Vapor retarder.
3. Roof insulation.

B. Section includes the installation of insulation strips in ribs of roof deck. Insulation strips are furnished under Section 053100 "Steel Decking."

C. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(e)12 and 16a-38k-4(b)4.
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
3. Section 072100 "Thermal Insulation" for insulation beneath the roof deck.
4. Section 077200 "Roof Accessories" for precast concrete splashblock to be installed as part of this section.
5. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
6. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
7. Section 221423 "Storm Drainage Piping Specialties" for roof drains.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

C. FM Global Requirements:

1. FM RoofNav Assembly Numbers
2. Application for Acceptance of Roofing: A copy of this document immediately follows this section.

D. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Roof plan showing orientation of steel roof deck and orientation of roofing, fastening spacings, and patterns for mechanically fastened roofing.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

E. Samples for Verification: For the following products:

1. Sheet roofing, of color required.
2. Walkway pads or rolls, of color required.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of compliance with performance requirements.

C. Product Test Reports: For components of roofing system, tests performed by manufacturer and witnessed by a qualified testing agency.

D. Research/Evaluation Reports: For components of roofing system, from ICC-ES.

E. Field quality-control reports.

F. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Thermoplastic Polyolefin (TPO) Roofing to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

B. Warranty: For Thermoplastic Polyolefin (TPO) Roofing specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.8 QUALITY ASSURANCE SUBMITTALS

A. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is FM Global approved for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.11 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.12 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories, roof expansion joints and other components of roofing system.
2. Warranty Period: 30 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carlisle SynTec Incorporated.
2. Firestone Building Products.
3. GenFlex Roofing Systems.

B. Source Limitations: Obtain components including roof insulation fasteners for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.

1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. FM Global Listing: Roofing, base flashings, and component materials shall comply with requirements in FM Global 4450 or FM Global 4470 as part of a built-up roofing system, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. FM RoofNav Assembly Numbers: Equivalent to 294816-0-0 and 294815-0-0.

2. Design Criteria:
   a. 95 mph wind speed
   b. Ground Roughness Coefficient: C
   c. Building Importance factor: 1.5

3. Fire/Windstorm Classification: Class 1-60
4. Hail-Resistance Rating: SH.

D. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

E. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.3 TPO ROOFING

A. Fabric-Reinforced TPO Sheet: ASTM D 6878, internally fabric- or scrim-reinforced, uniform, flexible TPO sheet.

1. Thickness: 80 mils (2.0mm), nominal.
2. Exposed Face Color: White.

2.4 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils (1.4 mm) thick, minimum, of same color as TPO sheet.

C. Bonding Adhesive: Manufacturer's standard, water based.

D. Slip Sheet: Manufacturer's standard, of thickness required for application.

E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

F. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), prepunched.

G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.

H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.5 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, Type X, 5/8 inch (16 mm) thick.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corporation; GlasRoc Sheathing.
b. Georgia-Pacific CorporationDens Deck Prime.
c. USG Corporation; Securock Glass Mat Roof Board.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate board to roof deck.

2.6 VAPOR RETARDER

A. Polyethylene Film: ASTM D 4397, 6 mils (0.15 mm) thick, minimum, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).

1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
2. Adhesive: Manufacturer's standard lap adhesive, FM Global approved for vapor-retarder application.

2.7 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by TPO roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Global-approved roof insulation.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Firestone Building Products.
b. Hunter Panels.
c. Johns Manville.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48) unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.8 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Full-spread spray-applied, low-rise, two-component urethane adhesive.

C. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch (13 mm) thick.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corporation; GlasRoc Sheathing.
b. Georgia-Pacific Corporation; Dens Deck Prime.
c. USG Corporation; Securock Glass Mat Roof Board.

2.9 WALKWAYS

A. Walkway Membrane: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway and rolls where indicated, approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.

1. Size: 30 inches wide x 10 foot long strips.

B. Walkway Pad: Walkway pad consisting of overlapping strips of UV resistant, 100%TPO compound with embossed surface to provide slip-resistance equal to X-Tred; Firestone Products.

1. Size: 30 inches wide.x 10 foot long strips.

2.10 ROOF WARRANTY SIGNS

A. Materials: Materials: Provide cast (not extruded or continuous cast) methyl methacrylate monomer psi when tested according to ASTM D 790, with a minimum allowable continuous service temperature of 176 deg F and of the following general types:

1. Opaque Sheet: Provide plaque sign that is manufactured from 1/8” thick laminated engraving stock.
2. Engraved Copy: Engraved copy characters through the first background layer to expose the contrasting color of the inner core of the engraving stock.

    a. Panel Size: 18”x20”, long side horizontal.
    b. Engraving Stock Thickness: 1/8inch minimum.
    c. Engraved Letter proportion: Letters and Numbers on signs shall have a width to height ratio between 3:5 and 1:1 and a stroke width to height ratio between1:5 and 1:10.
    d. Engraved Letter Size: Characters shall be 5/8 inch high.
    e. Background or first layer of engraving stock: Black
    f. Inner core of engraving stock: White
    g. Engraved letter style: Helvetica Medium with all upper case letters.
    h. Mounting Methods: Mechanical mounting as indicated in PART 3.11 of this section.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Global's "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof.

3.5 VAPOR-RETARDER INSTALLATION

A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively. Continuously seal side and end laps.

B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.6 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
   1. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together and adhere to roof insulation.

   1. Fasten cover boards according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
   2. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

I. Install slip sheet over cover board and immediately beneath roofing if recommended by the roofing manufacturer.

3.7 ADHERED ROOFING INSTALLATION

A. Adhere roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer, and allow to partially dry before installing roofing. Do not apply to splice area of roofing.

E. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeter of roofing.

F. Apply roofing with side laps shingled with slope of roof deck where possible.

G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions, to ensure a watertight seam installation.

   1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
   2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
   3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.8 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars if required by roofing manufacturer.

3.9 WALKWAY INSTALLATION

A. Walkway Membrane: Install walkway rolls in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions. Provide 2 inch wide gap between rolls.

Walkway Pads: Install walkway pads in locations indicated. Thread strips of TPO through pad and heat weld strips to roof membrane according to roofing system manufacturer's written instructions. Space strips at a maximum of 36 inches on center on both sides of the pads and at the roll end. Provide 2 inch wide gap between pads.

3.10 SPLASHBLOCK INSTALLATION

A. Splashblocks: Install splashblocks in locations indicated. Install an additional protective layer of membrane below splashblocks extending a minimum of 6 inches beyond the perimeter of the splashblock. . Heat weld to substrate or adhere additional protective layer substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.11 INSTALLATION OF WARRANTY SIGN

A. The Roof Warranty Sign shall be permanently anchored to the facility in an extruded aluminum with clear anodized finish frame, with stainless steel fasteners, adjacent to the roof hatch ladder, unless otherwise directed by the Engineer. Panel sign shall include the following information:

1. NEW ROOF INSTALLATION WARRANTY
2. CTDOT (Project 0431-0006): (District Name, coordinate with CDDOT)
3. WARRANTY START DATE: (X/X/XX) (Date of the issuance of the Certificate of Compliance)
4. ROOF TYPE: (Type of roof installed), (i.e. JoeSmith International, Inc. PVC Membrane)
5. WARRANTY: (Manufacturer’s name and type of warranty), 20 yr NDL
6. WARRANTY NUMBER: (Actual Warranty number)
7. INSTALLER: (Contractor's name, town located, and telephone number.)

8. AFTER 2 YEARS CONTACT MANUFACTURER: (Manufacturer’s name and telephone number of warranty service).

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.

B. Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D 5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

1. Flood to an average depth of 2-1/2 inches (65 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm). Maintain 2 inches (50 mm) of clearance from top of base flashing.
2. Flood each area for 24 hours.
3. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.

C. Perform pull-out test per ASTM E907.

D. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

E. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

F. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.13 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075423

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Formed low-slope roof sheet metal fabrications.
2. Formed wall sheet metal fabrications.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(d)9 and 16a-38k-4(d)11
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
3. Section 075423 “Thermoplastic Polyolefin (TPO) Roofing for installation of sheet metal flashing and trim integral with roofing.
4. Section 074213 “Metal Wall Panels” for sheet metal flashing and trim integral with metal wall panels.
5. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
6. Section 079500 "Expansion Control" for manufactured sheet metal expansion-joint covers.

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

C. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of edge conditions, including counterflashings..
9. Include details of special conditions.
10. Include details of connections to adjoining work.
11. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches (1:10).

D. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

E. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Warranty: For Sheet Metal Flashing and Trim specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.8 QUALITY ASSURANCE SUBMITTALS

A. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.9 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.11 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.

1. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Color: As selected by Architect from manufacturer's full range.
3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

C. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 (Z275) coating designation; prepainted by coil-coating process to comply with ASTM A 755/A 755M.

1. Surface: Smooth, flat.

2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

2.3 UNDERLAYMENT MATERIALS

A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

B. Self-Adhering, High-Temperature Sheet: Minimum 30 mils (0.76 mm) thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Grace Construction Products, a unit of W. R. Grace & Co.-Conn.; Grace Ice and Water Shield HT.
   b. Henry Company; Blueskin PE200 HT.
   c. Owens Corning; WeatherLock Specialty Tile & Metal Underlayment.

2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C) or higher.
3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C) or lower.

C. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. (0.16 kg/sq. m) minimum.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

   a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
   b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.

D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

D. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

E. Sealant Joints: Where movable, non-expansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

G. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

H. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

I. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer

J. Do not use graphite pencils to mark metal surfaces.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Aluminum: 0.040 inch (1.02 mm) thick.

B. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Aluminum: 0.032 inch (0.81 mm) thick.

2.7 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings; and form with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:

1. Metallic-Coated Steel Sheet: 0.050 inch thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:

1. Aluminum: 0.032 inch (0.81 mm) thick.

2.8 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Formed Insulation Stops (keynote 07 62 00.A2): Fabricate from the following materials:

1. Metallic-Coated Steel Sheet : 0.1196 inch thick.
2. Aluminum: 0.050 inch thick.

2.9 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Miscellaneous sheet metal flashings where indicated on drawings: Fabricate from the following materials:

1. Aluminum: 0.050 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps and edges with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners[**, solder**], protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
4. Torch cutting of sheet metal flashing and trim is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints minimum of 4 inches (100 mm). Secure in waterproof manner by means of interlocking folded seam and sealant unless otherwise indicated.

3.5 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

3.6 MISCELLANEOUS FLASHING INSTALLATION

A. Formed Insulation Stops : Coordinate installation of formed insulation stops with installation of wall

3.7 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.8 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean off excess sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof-edge specialties.
2. Roof-edge drainage systems.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 6a-38k-4(d)9
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
3. Section 076200 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
4. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, and other manufactured roof accessory units.
5. Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.
6. Section 079500 "Expansion Control" for manufactured sheet metal expansion-joint covers.

C. Preinstallation Conference: Conduct conference at Project site.

1. Conference to be held concurrently with preinstallation roofing conference. Refer to Section 075423 “Thermoplastic Polyolefin (TPO) Roofing for requirements.
2. Meet with Owner, Architect, Owner's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
4. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Shop Drawings: For roof specialties.

1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
4. Detail termination points and assemblies, including fixed points.
5. Include details of special conditions.

D. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: For each type of roof specialty.

C. Product Test Reports: For roof-edge flashings, for tests performed by a qualified testing agency.

D. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Roof Specialties to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

B. Warranty: For Roof Specialties specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class.

B. Source Limitations: Obtain roof specialties approved by manufacturer providing roofing-system warranty specified in Section 075423 “Thermoplastic Polyolefin (TPO) Roofing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 075423 “Thermoplastic Polyolefin (TPO) Roofing.

B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. FM Approvals' Listing: Manufacture and install roof-edge specialties that are listed in FM Approvals' "RoofNav" and FM Global Loss Prevention Data Sheet 1-49 and approved for windstorm classification, Class 1-60. Identify materials with FM Approvals' markings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 ROOF-EDGE SPECIALTIES

A. Roof-Edge Fascia: Manufactured, two-piece, roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet (3.6 m) and a continuous formed galvanized-steel cleat , 0.028 inch (0.71 mm) thick, minimum, with extended vertical leg terminating in a drip-edge cleat. Provide matching corner units.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Edge Systems One Gravel Stop; Metal Era, Inc.

2. Extruded-Aluminum Fascia Covers: Extruded aluminum, Min. 0.080 inch (2.03 mm) thick.

   a. Finish: Two-coat fluoropolymer.
   b. Color: Custom color, as selected by Architect..

3. Corners: Factory mitered and continuously welded.
4. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.

2.3 ROOF-EDGE DRAINAGE SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hickman Company, W. P.
2. Metal-Era, Inc.
3. Perimeter Systems; a division of Southern Aluminum Finishing Company, Inc.

B. Gutters: Manufactured in uniform section lengths not exceeding 12 feet (3.6 m), with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch (25 mm) above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.

1. Aluminum Sheet: 0.050 inch (1.27 mm) thick.
2. Gutter Profile: Style A according to SMACNA's "Architectural Sheet Metal Manual."
3. Corners: Factory mitered and continuously welded.

4. Gutter Supports: Straps with finish matching the gutters.

C. Downspouts: Plain rectangular complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.

1. Formed Aluminum: 0.050 inch (1.27 mm) thick.

D. Aluminum Finish: Two-coat fluoropolymer.

1. Color: Custom color, as selected by Architect..

2.4 REGLETS AND COUNTERFLASHINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fry Reglet Corporation.
2. Hickman Company, W. P.
3. Metal-Era, Inc.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

1. Formed Aluminum: 0.050 inch (1.27 mm) thick.
2. Corners: Factory mitered and continuously welded.
3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
4. Stucco Type, Embedded: Provide reglets with upturned fastening flange and extension leg of length to match thickness of applied finish materials.
5. Concrete Type, Embedded: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
6. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.

C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 feet (3.6 m) designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:

1. Formed Aluminum: 0.032 inch (0.81 mm) thick.

D. Accessories:

1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

2.5 MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

C. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:

2.6 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: ASTM D 1970/D 1970M; stable after testing at 240 deg F (116 deg C).
2. Low-Temperature Flexibility: ASTM D 1970/D 1970M; passes after testing at minus 20 deg F (29 deg C).
3. Products: Subject to compliance with requirements, provide one of the following:

   a. Carlisle Coatings & Waterproofing; CCW WIP 300HT.
   b. Henry Company; Blueskin PE200 HT.
   c. Owens Corning; WeatherLock Metal High Temperature Underlayment.

B. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

C. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum.

2.7 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.

B. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

C. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

E. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.8 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Coil-Coated Aluminum Sheet Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

E. Aluminum Extrusion Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

1. Apply continuously under roof-edge specialties and reglets and counterflashings.
2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

B. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

C. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

3.3 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise indicated on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).

3.4 ROOF-EDGE SPECIALITIES INSTALLATION

A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.5 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 24 inches (610 mm) apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.

1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet (15.2 m) apart. Install expansion-joint caps.
2. Install continuous leaf guards on gutters with noncorrosive fasteners, hinged to swing open for cleaning gutters.

C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 30 inches (750 mm) o.c.

1. Provide elbows at base of downspouts at grade to direct water away from building.

3.6 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077100

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment supports.
2. Roof hatches.
3. Pipe supports.
4. Preformed flashing sleeves.
5. Precast concrete splashblock.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4.
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.
2. Section 055100 "Metal Stairs" for stairs for access to roof hatches.
3. Section 076200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, and miscellaneous sheet metal trim and accessories.
4. Section 077100 "Roof Specialties" for manufactured fasciae, copings, gravel stops, and counterflashing.
5. Section 086200 "Unit Skylights" for skylights mounted on site erected curbs.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Shop Drawings: For roof accessories. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

D. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

1.5 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Roof Accessories to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

B. Warranty: For Roof Accessories specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 QUALITY ASSURANCE SUBMITTALS

A. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.8 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leak-proof, weather-tight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.9 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

1. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer Finish: AAMA 620. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.

2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil (0.013 mm).

B. Aluminum Extrusions and Tubes: ASTM B 221 (ASTM B 221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.

C. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.

D. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.

E. Steel Tube: ASTM A 500, round tube.

F. Galvanized-Steel Tube: ASTM A 500, round tube, hot-dip galvanized according to ASTM A 123/A 123M.

G. Steel Pipe: ASTM A 53/A 53M, galvanized.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Glass-Fiber Board Insulation: ASTM C 726, thickness as indicated.

C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

E. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

G. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane or silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

H. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.3 EQUIPMENT SUPPORTS

A. Equipment Supports: Internally reinforced metal equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, integral metal cant, and stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Greenheck Fan Corporation.
   b. LM Curbs.
   c. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Loads: Refer to drawings.

D. Material: Aluminum sheet, 0.090 inch (2.28 mm) thick.

1. Finish: Two-coat fluoropolymer .
2. Color: As selected by Architect from manufacturer's full range.

E. Construction:

1. Insulation: Factory insulated with 1-1/2-inch- (38-mm-) thick glass-fiber board insulation.
2. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.

3. Factory-installed continuous wood nailers 3-1/2 inches (90 mm) wide at tops of equipment supports.
4. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
5. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
6. Fabricate equipment supports to minimum height of 12 inches (300 mm) unless otherwise indicated.
7. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.

2.4 ROOF HATCH

A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, integral metal cant, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Babcock-Davis.
   b. Bilco Company (The).
   c. Nystrom.

B. Type and Size: Single-leaf lid, 30 by 96 inches (750 by 2440 mm).

C. Loads: Minimum 40-lbf/sq. ft. (1.9-kPa) external live load and 20-lbf/sq. ft. (0.95-kPa) internal uplift load.

D. Hatch Material: Aluminum sheet, 0.090 inch (2.28 mm) thick.

1. Finish: Two-coat fluoropolymer.
2. Color: As selected by Architect from manufacturer's full range.

E. Construction:

1. Insulation: Glass-fiber board.
2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
4. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
5. Fabricate curbs to minimum height of 12 inches (300 mm) unless otherwise indicated.

F. Hardware: Galvanized-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.

1. Provide two-point latch on lids larger than 84 inches (2130 mm).

2.5 PIPE SUPPORTS

A. Pipe Supports: Adjustable-height, extruded-aluminum tube, filled with urethane insulation; 2 inches (50 mm) in diameter; with aluminum baseplate, EPDM base seal, manufacturer's recommended hardware for mounting to structure or structural roof deck as indicated, and extruded-aluminum carrier assemblies; suitable for quantity of pipe runs and sizes.

1. Basis-of-Design Manufacturers: Subject to compliance with requirements, provide products by Thaler Metal USA Inc.
2. Pipe Support Height: As indicated on Drawings.
3. Roller Assembly: With stainless-steel roller, sized for supported pipes.
4. Pipe Support Flashing: Manufacturer's standard insulated sleeve flashing with integral base flange; aluminum sheet, 0.063 inch (1.60 mm) thick.
5. Finish: Manufacturer's standard.

B. Light-Duty Pipe Supports: Extruded-aluminum base assembly and Type 304 stainless-steel roller assembly for pipe sizes indicated, including manufacturer's recommended load-distributing baseplate.

1. Basis-of-Design Manufacturers: Subject to compliance with requirements, provide products by Thaler Metal USA Inc.
2. Finish: Manufacturer's standard

2.6 PRECAST CONCRETE SPLASHBLOCK

A. Precast Concrete Splash Block: Manufacturers standard profile and the following:

a. Basis-of-Design Manufacturers: Subject to compliance with requirements, provide products by Modern Precast Inc.

2. Size: 30 inches long by 12 inches wide by 1 1/8 inches thick (3 inches at deepest Cement: Portland cement, Type 1 or 2 conforming to ASTM C 150.
3. Aggregates: Course and fine conforming to ASTM C 33.
4. Admixtures: ASTM C 494.
5. Water: Potable.
6. Pigments: Bayferrox inorganic, synthetic iron oxide pigments, lime proof and non-fading conforming to ASTM C 979.
7. Reinforcing Steel: Conform to ASTM 615 and deformation to ASTM M 305.
8. Compressive Strength: Min. 4000 psi
9. Color: As selected by Architect from manufacturer's full range.

2.7 PREFORMED FLASHING SLEEVES

A. Exhaust Vent Flashing: Double-walled metal flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches (300 mm) high, with removable metal hood and slotted metal collar.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Custom Solution Roof and Metal Products.
b. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
c. Thaler Metal USA Inc.

2. Metal: Aluminum sheet, 0.063 inch (1.60 mm) thick.
3. Diameter: As indicated.
4. Finish: Manufacturer's standard.

B. Vent Stack Flashing: Metal flashing sleeve, uninsulated, with integral deck flange.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Custom Solution Roof and Metal Products.
b. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
c. Thaler Metal USA Inc.

2. Metal: Aluminum sheet, 0.063 inch (1.60 mm) thick.
3. Height: 13 inches (330 mm).
4. Diameter: As indicated.
5. Finish: Manufacturer's standard.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum and stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

D. Roof-Hatch Installation:

1. Install roof hatch so top surface of hatch curb is level.
2. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
3. Attach safety railing system to roof-hatch curb.
4. Attach ladder-assist post according to manufacturer's written instructions.

E. Pipe Support Installation: Install pipe supports so top surfaces are in contact with and provide equally distributed support along length of supported item.

F. Preformed Flashing-Sleeve Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions.

G. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

A. Clean exposed surfaces according to manufacturer's written instructions.

B. Clean off excess sealants.

C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 078123 - INTUMESCENT FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes mastic and intumescent fire-resistive coatings (MIFRC).

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)5
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review products, design ratings, restrained and unrestrained conditions, thicknesses, and other performance requirements.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

C. FM Global Requirements: Products must be listed in FM Global's "Building Materials Approval Guide".

D. Shop Drawings: Structural framing plans indicating the following:

1. Extent of fireproofing for each construction and fire-resistance rating.
2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
4. Treatment of fireproofing after application.

E. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard dimensions in size.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of fireproofing.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE SUBMITTALS

A. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. Firm must also be approved by FMG according to FMG 4991, “Approval of Fireproofing Contractors”.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each coating.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 50 deg F (10 deg C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

B. Source Limitations: Obtain fireproofing from single source.

C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

D. Asbestos: Provide products containing no detectable asbestos.

2.2 MASTIC AND INTUMESCENT FIRE-RESISTIVE COATINGS

A. MIFRC: Manufacturer's standard, factory-mixed formulation or factory-mixed, multicomponent system consisting of intumescent base coat and topcoat, and complying with indicated fire-resistance design.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Albi Manufacturing, Division of StanChem Inc.; Albi Clad TF.
b. Carboline Company, subsidiary of RPM International, Fireproofing Products Div.; AD Firefilm III andr Nullifire S607.
c. Isolatek International; Cafco SprayFilm-WB 3 and Cafco SprayFilm-WB 4.

2. Application: Designated for "conditioned interior space purpose" use by a qualified testing agency acceptable to authorities having jurisdiction.
3. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design.
4. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

5. Hardness: Not less than 65, Type D durometer, according to ASTM D 2240.
6. Finish: Spray-textured finish.Consider retaining "Color and Gloss" Subparagraph below if important to Project's appearance; consult manufacturer for recommendations.

a. Color and Gloss: As selected by Architect from manufacturer's full range.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

C. Topcoat: Suitable for application over applied fireproofing; of type recommended in writing by fireproofing manufacturer for each fire-resistance design.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design. Verify compliance with the following:

1. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
2. Objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
3. Substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.

B. Conduct tests according to fireproofing manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.

B. Clean substrates of substances that could impair bond of fireproofing.

C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.

D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.

1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.

D. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written recommendations for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.

E. Spray apply fireproofing to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.

F. Extend fireproofing in full thickness over entire area of each substrate to be protected.

G. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.

H. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.

I. Cure fireproofing according to fireproofing manufacturer's written recommendations.

J. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

K. Finishes: Where indicated, apply fireproofing to produce the following finishes:
1. Spray-Textured Finish: Finish left as spray applied with no further treatment.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Test and inspect as required by the IBC, 1704.11.

B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Fireproofing will be considered defective if it does not pass tests and inspections.

1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing will be without damage or deterioration at time of Substantial Completion.

C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.

D. Repair fireproofing damaged by other work before concealing it with other construction.

E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 078123

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.

B. Related Sections include the following:

1. Division 01, High Performance Buildings Requirements Section for credit 16a-38k-4(b)4.
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Division 7 Section "Fire-Resistive Joint Systems."
3. Division 21 Sections specifying fire-suppression piping penetrations.
4. Division 22 and 23 Sections specifying duct and piping penetrations.
5. Division 26, 27 and 28 Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to FM Global and requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls including fire walls, fire partitions, fire barriers, and smoke barriers.
2. Fire-resistance-rated horizontal assemblies including floors, and floor/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

a. Penetrations located outside wall cavities.
b. Penetrations located outside fire-resistance-rated shaft enclosures.

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches (100 mm) in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. FM Global Requirements: Products must be listed in FM Global's "Building Materials Approval Guide".

D. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
2. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly prepared in accordance with the International Firestop Council's Guidelines for Evaluating Firestop Systems Engineering Judgements..

E. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:

1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.

3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

F. Qualification Data: For Installer and independent inspecting agency.

G. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.

1.5 QUALITY ASSURANCE SUBMITTALS

A. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Individuals installing firestop materials should have documented proof of training directly from the firestop manufacturer. Training by third party resellers is not sufficient. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer. Firm must also be approved by FMG according to FMG 4991, “Approval of Fireproofing Contractors”.

B. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, OPL, ITS, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:

   a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
   b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:

      1) UL in its "Fire Resistance Directory."
      2) OPL in its "Directory of Listed Building Products, Materials, & Assemblies."
      3) ITS in its "Directory of Listed Products."
      4) FM Global in its "Building Materials Approval Guide."

C. Preinstallation Conference: Conduct conference at Project site..

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls including fire walls, fire partitions, fire barriers, and smoke barriers.
2. Fire-resistance-rated horizontal assemblies including floors, and floor/ceiling assemblies.

B. Coordinate size and location of cast-in-place firestop devices to accommodate through-penetrating items. Ensure proper placement of devices before placement of concrete.

C. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

D. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

E. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

F. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers:

1. Grace, W. R. & Co. - Conn.
2. Hilti, Inc.
3. Tremco; Sealant/Weatherproofing Division.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:
   a. Slag-/rock-wool-fiber insulation.
   b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
   c. Fire-rated form board.
   d. Fillers for sealants.
2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.3 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by referencing the types of materials described in this Article. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.

B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic or polypropylene sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, pour stop and fastening adapters, and a neoprene gasket.

C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.

F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

H. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

I. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.

J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

K. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.
2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

L. Acrylic Sealants: Single components, acrylic-based, neutral-curing sealants, either elastomeric or intumescent.

M. Foam "Sponge-Like" Blocks: Re-penetratable intumescent blocks that may be friction-fit, deformed, or cut to fit in through penetration openings.

N. Foam "Sponge-Like" Plugs: Re-penetrable intumescent plugs that may be cut and friction-fit in through penetration openings.

O. Polyurethane Foam: Two-part, expanding, intumescent polyurethane foam, dispensed from a coaxial tube through a mixing nozzle such that the two components are mixed throughly and in the proper porportions.

2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:

1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Maintenance of Any Damage." Indication that the penetration is firerated.
2. Contractor's name, address, and phone number.
3. Through-penetration firestop system designation of applicable testing and inspecting agency.
4. Date of installation.
5. Through-penetration firestop system manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Contractor shall engage a qualified, independent inspecting agency to inspect through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to agency qualifications, preconstruction meetings, mock-ups, conducting inspections, destructive testing, and preparing test reports.

B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.6 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413

SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes fire-resistive joint systems for the following:

1. Floor-to-wall joints.
2. Head-of-wall joints.
3. Wall-to-wall joints.

B. Related Sections include the following:

1. Division 01, High Performance Buildings Requirements Section for credit 16a-38k-4(b)4.
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.
2. Division 7 Section "Penetration Firestopping" for systems installed in openings in walls and floors with and without penetrating items.
3. Division 7 Section "Joint Sealants" for non-fire-resistive joint sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide fire-resistive joint systems that are produced and installed to resist spread of fire according to FM Global and requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed.

B. Joint Systems in and between Fire-Resistance-Rated Constructions: Provide systems with assembly ratings equaling or exceeding the fire-resistance ratings of construction that they join, and with movement capabilities indicated as determined by UL 2079.

1. Load-bearing capabilities as determined by evaluation during the time of test.

C. For fire-resistive systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. FM Global Requirements: Products must be listed in FM Global's "Building Materials Approval Guide".

D. Shop Drawings: For each fire-resistive joint system, show each kind of construction condition in which joints are installed; also show relationships to adjoining construction. Include fire-resistive joint system design designation of testing and inspecting agency acceptable to authorities having jurisdiction that demonstrates compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction and penetrating items.
2. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgement or equivalent fire-resistance-rated assembly prepared in accordance with the International Firestop Council's Guidelines for Evaluating Firestop Systems Engineering Judgements.

E. Product Certificates: For each type of fire-resistive joint system, signed by product manufacturer.

F. Qualification Data: For Installer and independent inspecting agency. Coordinate with Division 7 Section "Penetration Firestopping".

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include direct training by fire resistive joint system manufacturer, having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer. Firm must also be approved by FMG according to FMG 4991, "Approval of Fireproofing Contractors".

B. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, OPL or another agency performing testing and follow-up inspection services for fire-resistive joint systems acceptable to authorities having jurisdiction.
2. Fire-resistive joint systems are identical to those tested per methods indicated in Part 1 "Performance Requirements" Article and comply with the following:

a. Fire-resistive joint system products bear classification marking of qualified testing and inspecting agency.
b. Fire-resistive joint systems correspond to those indicated by referencing system designations of the qualified testing and inspecting agency.

3. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

C. Notify Owner's inspecting agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up fire-resistive joint system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector of authorities having jurisdiction have examined each installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the fire-resistive joint systems for each application that are produced by one of the following manufacturers:

1. Manufacturers listed in Division 7 Section “Penetration Firestopping”.
2. Manufacturers (not necessarily products) listed in Division 7 Section “Joint Sealants”.

2.2 FIRE-RESISTIVE JOINT SYSTEMS

A. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.

B. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

C. Designation System for Joints in or between Fire-Resistance-Rated Constructions: Alphanumeric systems listed in UL's "Fire Resistance Directory" under Product Category XHBN.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates or damaging adjoining surfaces.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with Part 1 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.

B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Inspecting Agency: Contractor shall engage a qualified independent inspecting agency to inspect fire-resistive joint systems and prepare inspection reports.

B. Testing Services: Inspecting of completed installations of fire-resistive joint systems shall take place in successive stages as installation of fire-resistive joint systems proceeds. Do not proceed with installation of joint systems for the next area until inspecting agency determines completed work shows compliance with requirements.

1. Inspecting agency shall state in each report whether inspected fire-resistive joint systems comply with or deviate from requirements.

C. Remove and replace fire-resistive joint systems where inspections indicate that they do not comply with specified requirements.

D. Additional inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and fire-resistive joint systems comply with requirements.

3.5 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 078446

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in vertical surfaces and non-traffic horizontal surfaces.
2. Interior joints in vertical surfaces and horizontal non-traffic surfaces.
3. Interior joints in horizontal traffic surfaces.

B. Related Sections include the following:

1. Division 01, High Performance Buildings Requirements Section for credit 16a-38k-4(b)4
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.
2. Division 4 Section "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
3. Division 7 Section "Fire-Resistive Joint Systems" for fire-resistant building joint-sealant systems.
4. Division 8 Section "Glazing" for glazing sealants.
5. Division 9 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters of acoustical ceilings.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each joint-sealant product indicated.

C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

D. Samples for Verification: For each type and color of joint sealant required. Install joint sealants in 1/2-inch (13-mm) wide joints formed between two 6-inch (150-mm) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

E. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

F. Preconstruction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.

G. Field Test Report Log: For each elastomeric sealant application. Include information specified in "Field Quality Control" Article.

H. Compatibility and Adhesion Test Reports: From sealant manufacturer indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

I. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE SUBMITTALS

A. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.6 CLOSEOUT SUBMITTALS

A. Warranty: For Joint Sealants specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to joint substrates as follows:

1. Locate test joints where indicated or, if not indicated, as directed by Architect.

2. Conduct field tests for each application indicated below:

   a. Each type of elastomeric sealant and joint substrate indicated.

3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint sealant manufacturer's technical representative present.
5. Test Method: Test joint sealants by hand-pull method described below:

   a. Install joint sealants in 60-inch (1500-mm) long joints using same materials and methods for joint preparation and joint-sealant installation required for the completed Work. Allow sealants to cure fully before testing.
   b. Make knife cuts from one side of joint to the other, followed by two cuts approximately 2 inches (50 mm) long at sides of joint and meeting cross cut at one end. Place a mark 1 inch (25 mm) from cross-cut end of 2-inch (50-mm) piece.
   c. Use fingers to grasp 2-inch (50-mm) piece of sealant between cross-cut end and 1-inch (25-mm) mark; pull firmly at a 90-degree angle or more in direction of side cuts while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.
   d. For joints with dissimilar substrates, check adhesion to each substrate separately. Do this by extending cut along one side, checking adhesion to opposite side, and then repeating this procedure for opposite side.

6. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
7. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

D. Mockups: Before installing joint sealants, apply elastomeric sealants as follows to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution:

   1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

E. Preinstallation Conference: Conduct conference at Project.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer.
2. When joint substrates are wet.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.10 WARRANTY

A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Manufacturer's Warranty: Written warranty, signed by elastomeric sealant manufacturer agreeing to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.
2. Failures of elastomeric joint sealants covered under this Warranty include, but are not limited to cracking, crumbling, reversion, staining of adjacent substrates, water penetration, splitting, separation from substrates, and failure to maintain a weathertight seal.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: Custom colors as selected by the Architect.

C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

2.2 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant, including those referencing ASTM C 920 classifications for type, grade, class, and uses.

B. Additional Movement Capability: Where additional movement capability is specified, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at the time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.

C. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Medium-Modulus Neutral-Curing Silicone Sealant: Provide products complying with the following:

1. Products: Provide one of the following:

   a. 756 SMS; Dow Corning.
   b. 895NST; Pecora Corporation.
   c. Spectrem 2; Tremco.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 50.
4. Additional Movement Capability: 50% movement in extension and 50% movement in compression for a total of 100% movement.
5. Use[s] Related to Exposure: NT (non-traffic).
6. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
7. Stain-Test Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.
8. Dust and Dirt Attraction: Non-attracting to dust and dirt.
9. Applications: Exterior vertical and horizontal non-traffic joints, such as perimeter joints of door, window, louver or other exterior openings, joints between different materials, expansion/control joints; and interior vertical and horizontal non-traffic expansion joints.

E. Mildew-Resistant Silicone Sealant: Provide products formulated with fungicide that are intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes, and that comply with the following:

1. Products: Provide one of the following:

   a. 786 Mildew Resistant; Dow Corning.
   b. 898 Silicone Sanitary Sealant; Pecora Corporation.
   c. Tremsil 600 White; Tremco.

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (non-traffic).
5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.

6. Applications: Joints between plumbing fixtures and adjacent construction, other joints in toilet and/or shower rooms.

F. Multicomponent Nonsag Urethane Sealant: Provide products complying with the following:

1. Products: Provide one of the following:

a. Dynatred; Pecora Corporation.
b. Sikaflex-2cNS; Sika Corporation.
c. THC 901; Tremco.

2. Type and Grade: M (multicomponent) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: T (traffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
6. Applications: Interior expansion and control joints in floors.

G. Multicomponent Pourable Urethane Sealant: Provide products complying with the following:

1. Products: Provide one of the following:

a. NR-200 Urexpan; Pecora Corporation.
b. Sikaflex - 2c SL; Sika Corporation.
c. THC-900; Tremco.

2. Type and Grade: M (multicomponent) and P (pourable).
3. Class: 25.
4. Use Related to Exposure: T (traffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
6. Applications: Interior expansion and control joints in low slope or flat floors.

2.3 LATEX JOINT SEALANTS

A. Latex Sealant Standard: Comply with ASTM C 834.

B. Latex Sealant: Provide products complying with the following:

1. Products: Provide one of the following:

a. AC-20; Pecora Corporation.
b. Sonolac; Sonneborn Building Products Div., ChemRex, Inc.
c. Tremflex 834; Tremco.

2. Applications: Interior vertical and horizontal non-traffic, non-expansion joints.

2.4 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Concealed Joints: Provide manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.

1. Products: Provide one of the following:

a. BA-98; Pecora Corporation.
b. Tremco Acoustical Sealant; Tremco.
c. SHEETROCK Acoustical Sealant; USG Corp., United States Gypsum Co.

2. Applications: Joints in sound-rated construction and elsewhere as may be indicated.

2.5 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Type C: Closed-cell material with a surface skin.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air. Porous joint surfaces include, but are not limited to the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous surfaces include, but are not limited to the following:

    a. Metal.
    b. Glass.
    c. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.

F. Install sealants by proven techniques to comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field-test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed elastomeric sealant joints as follows:

   a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each type of elastomeric sealant and joint substrate.
   b. Perform one test for each 1000 feet (300 m) of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants by hand-pull method described below:

   a. Make knife cuts from one side of joint to the other, followed by two cuts approximately 2 inches (50 mm) long at sides of joint and meeting cross cut at one end. Place a mark 1 inch (25 mm) from cross-cut end of 2-inch (50-mm) piece.
   b. Use fingers to grasp 2-inch (50-mm) piece of sealant between cross-cut end and 1-inch (25-mm) mark; pull firmly at a 90-degree angle or more in direction of side cuts while holding a ruler along side of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but

not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.

c. For joints with dissimilar substrates, check adhesion to each substrate separately. Do this by extending cut along one side, checking adhesion to opposite side, and then repeating this procedure for opposite side.

3. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field adhesion test log.
4. Inspect tested joints and report on the following:

   a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field- adhesion hand-pull test criteria.
   b. Whether sealants filled joint cavities and are free from voids.
   c. Whether sealant dimensions and configurations comply with specified requirements.

5. Record test results in a field adhesion test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
6. Repair sealants pulled from test area by applying new sealants following same procedures used to originally seal joints. Ensure that original sealant surfaces are clean and new sealant contacts original sealant.

B. Evaluation of Field-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements, will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 079200

SECTION 079500 - EXPANSION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior expansion control systems.
2. Exterior wall expansion control systems.
3. Parking expansion control systems.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credit 16a-38k-4(b)4
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.
2. Section 033000 "Cast-In-Place Concrete" for expansion and isolation joints located within the building.
3. Section 078446 "Fire-Resistive Joint Systems" for liquid-applied joint sealants in fire-resistive building joints.
4. Section 079200 "Joint Sealants" for liquid-applied joint sealants and for elastomeric sealants without metal frames.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Shop Drawings: For each expansion control system specified. Include plans, elevations, sections, details, splices, blockout requirement, attachments to other work, and line diagrams showing entire route of each expansion control system. Where expansion control systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect.

C. Samples: For each exposed expansion control system and for each color and texture specified, full width by 6 inches (150 mm) long in size.

D. Samples for Initial Selection: For each type of expansion control system indicated.

1. Include manufacturer's color charts showing the full range of colors and finishes available for each exposed metal and elastomeric seal material.

E. Samples for Verification: For each type of expansion control system indicated, full width by 6 inches (150 mm) long in size.

F. Product Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:

1. Manufacturer and model number for each expansion control system.
2. Expansion control system location cross-referenced to Drawings.
3. Nominal joint width.
4. Movement capability.
5. Classification as thermal or seismic.
6. Materials, colors, and finishes.
7. Product options.
8. Fire-resistance ratings.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each fire barrier provided as part of an expansion control system, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. General: Provide expansion control systems of design, basic profile, materials, and operation indicated. Provide units with capability to accommodate variations in adjacent surfaces.

1. Furnish units in longest practicable lengths to minimize field splicing. Install with hairline mitered corners where expansion control systems change direction or abut other materials.
2. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion control systems.

B. Coordination: Coordinate installation of exterior wall and soffit expansion control systems with roof expansion control systems to ensure that wall transitions are watertight. Roof expansion joint assemblies are specified elsewhere.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Where indicated, provide expansion control systems with fire barriers identical to those of systems tested for fire resistance per UL 2079 or ASTM E 1966 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Hose Stream Test: Wall-to-wall and wall-to-ceiling systems shall be subjected to hose stream testing.

B. Seismic Performance: Expansion control systems shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event.
2. Component Importance Factor: Refer to Structural drawings.

2.3 INTERIOR EXPANSION CONTROL SYSTEMS

A. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated.

B. Source Limitations: Obtain expansion control systems from single source from single manufacturer.

C. Floor-to-Floor (EC-1):

1. Basis-of-Design Product: FJF-200; Watson Bowman Acme Corp.; a BASF Construction Chemicals Business.
2. Design Criteria:

a. Nominal Joint Width: 2 inches.
b. Minimum Joint Width: 0 inches.
c. Maximum Joint Width: 3 1/4 inches.
d. Type of Movement: Seismic.
e. Load Capacity:

1) Uniform Load: 150 lb/sq. ft. (732 kg/sq. m).
2) Concentrated Load: 2000 lb (907 kg).
3) Maximum Deflection: 0.5 inch (13 mm).

3. Type: Cover plate.

a. Cover-Plate Design: Serrated.

b. Metal: Aluminum.

1) Finish: Clear anodic, Class II.

D. Floor-to-Wall (EC-2):

1. Basis-of-Design Product: FJF-200c; Watson Bowman Acme Corp.; a BASF Construction Chemicals Business.
2. Design Criteria:

a. Nominal Joint Width: 2 inches.
b. Minimum Joint Width: 0 inches.

c. Maximum Joint Width: 3 1/4 inches.
d. Type of Movement: Seismic.

3. Type: Cover plate.

a. Cover-Plate Design: Plain.
b. Metal: Aluminum.

1) Finish: Clear anodic, Class II.

E. Wall-to-Wall (EC-3):

1. Basis-of-Design Product: EWH-200; Watson Bowman Acme Corp.; a BASF Construction Chemicals Business.
2. Design Criteria:

a. Nominal Joint Width: 2 inches.
b. Minimum Joint Width: 1 inch.
c. Maximum Joint Width: 3 inch.
d. Type of Movement: Seismic.
e. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.
1) Basis-of-Design Products:
a) Vertical (EC-3a): VTS-2; Watson Bowman Acme Corp.; a BASF Construction Chemicals Business.
b) Horizontal (EC-3b): HTS-2; Watson Bowman Acme Corp.; a BASF Construction Chemicals Business.

3. Type: Cover plate with slide gasket.

a. Metal: Aluminum.

1) Finish: Clear anodic, Class II.

F. Wall to Wall Corner (EC-4):

1. Basis-of-Design Product: EWH-200c; Watson Bowman Acme Corp.; a BASF Construction Chemicals Business.
2. Design Criteria:

a. Nominal Joint Width: 2 inches.
b. Minimum Joint Width: 1 inch.
c. Maximum Joint Width: 3 inches.
d. Type of Movement: Seismic.

3. Type: Cover plate with slide gasket.

a. Metal: Aluminum.

1) Finish: Clear anodic, Class II.

G. Wall-to-Ceiling (EC-5):

1. Basis-of-Design Product: CWCA-200c; Watson Bowman Acme Corp.; a BASF Construction Chemicals Business.
2. Design Criteria:

   a. Nominal Joint Width: 2 inches.
   b. Minimum Joint Width: 1 1/2 inches.
   c. Maximum Joint Width: 2 1/2 inches.
   d. Type of Movement: Seismic.

3. Type: Dual elastomeric seal.

   a. Metal: Aluminum.

      1) Finish: Mill.

   b. Seal Material: Extruded PVC..

      1) Color: White

H. Ceiling-to-Ceiling (EC-6):

1. Basis-of-Design Product: CWCA-200; Watson Bowman Acme Corp.; a BASF Construction Chemicals Business .
2. Design Criteria:

   a. Nominal Joint Width: 2 inches.
   b. Minimum Joint Width: 1 1/2 inches.
   c. Maximum Joint Width: 2 1/2 inches.
   d. Type of Movement: Seismic.

3. Type: Dual elastomeric seal.

   a. Metal: Aluminum.

      1) Finish: Mill.

   b. Seal Material: Extruded PVC.

      1) Color: White.

2.4 ACOUSTIC JOINT FILLER (EC-7)

A. Basis-of-Design Product: Subject to compliance with requirements, provide Quiet Joint SHG; EMSEAL Corporation.

B. Self-extinguishing, fire retardant acrylic impregnated foam, factory pre-coated with silicone. UV stable, non-staining, low temperature flexible, high temperature stable.

C. STC: 53 per ASTM E90-09.

D. OITC: 38 per ASTM E90-09.

E. R-value: R-2.848/ inch of depth per ASTM C518-04.

F. Color: As selected by Architect from manufacturers full range.

2.5 EXTERIOR WALL EXPANSION CONTROL SYSTEMS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated.

B. Wall-to-Wall (EC-8):

1. Basis-of-Design Product: SWS-200; Sesmic Weather Seal, Watson Bowman Acme Corp.; a BASF Construction Chemicals Business
2. Design Criteria:

    a. Nominal Joint Width: 2 inches.
    b. Minimum Joint Width: 1 inch.
    c. Maximum Joint Width: 3 inches.
    d. Type of Movement: Seismic.
    e. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than that indicated.

3. Type: Preformed cellular foam.

    a. Foam Material: Open-cell polyurethane foam with factory applied elastomeric silicone membrane coating.

4. Color: Equal to Charcoal; Watson Bowman Acme Corp.; a BASF Construction Chemicals Business

2.6 PARKING EXPANSION CONTROL SYSTEMS

A. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated.

B. Source Limitations: Obtain expansion control systems from single source from single manufacturer.

C. Slab-to-Slab (EC-9):

1. Basis-of-Design Product: HSeal, 50EH; Watson Bowman Acme Corp.; a BASF Construction Chemicals Business .
2. Design Criteria:

    a. Nominal Joint Width: 2 inches.
    b. Minimum Joint Width: 1 inch.
    c. Maximum Joint Width: 3 inches.
    d. Type of Movement: Seismic.
    e. Load Capacity:

1) Uniform Load: 150 lb/sq. ft. (732 kg/sq. m).
2) Concentrated Load: 2000 lb (907 kg).
3) Maximum Deflection: 0.5 inch (13 mm).

3. Type: Preformed cellular foam with elastomeric coating.

a. Foam Material: Polyurethane.

1) Elastomeric Coating Color: Gray.

D. Wall-to-Wall (EC-10):

1. Basis-of-Design Product: Evazote; Watson Bowman Acme Corp.; a BASF Construction Chemicals Business.
2. Design Criteria:

a. Nominal Joint Width: 2 inches.
b. Minimum Joint Width: 1 inch.
c. Maximum Joint Width: 3 1/4 inches.
d. Type of Movement: Seismic.

3. Type: Preformed cellular foam.

a. Foam Material: Non-extruded, low-density, crosslinked, nitrogen-blown, ethylene-vinyl-acetate polyethylene.

1) Color: As selected by Architect from manufacturer's full range.

2.7 MATERIALS

A. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), Alloy 6061-T6 for sheet and plate.

1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

B. Elastomeric Seals: ASTM E 1783; preformed elastomeric membranes or extrusions to be installed in metal frames.

C. Compression Seals: ASTM E 1612; preformed elastomeric extrusions having an internal baffle system and designed to function under compression.

D. Cellular Foam Seals: Extruded, compressible foam designed to function under compression.

E. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required fire-resistance rating.

F. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

A. Mill finish.

B. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces where expansion control systems will be installed for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to expansion control system manufacturer's written instructions.

Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion control systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion control systems.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing expansion control systems and acoustic joint filler materials unless more stringent requirements are indicated.

B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion control systems.

1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation. Notify Architect where discrepancies occur that will affect proper expansion control system installation and performance.
3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.

4. Install frames in continuous contact with adjacent surfaces.

   a. Shimming is not permitted.

5. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.

C. Seals in Metal Frames: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.

1. Provide in continuous lengths for straight sections.
2. Seal transitions according to manufacturer's written instructions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

D. Compression Seals: Apply adhesive or lubricant adhesive as recommended by manufacturer.

E. Foam Seals: Install with adhesive recommended by manufacturer.

F. Terminate exposed ends of expansion control systems with field- or factory-fabricated termination devices.

G. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion control system materials and associated work so complete assemblies comply with assembly performance requirements.

1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

3.4 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, install temporary protection over expansion control systems.

END OF SECTION 079500

SECTION 080671 – DOOR HARDWARE SCHEDULE

DOOR HARDWARE SETS

A. The door hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. The supplier is responsible for handing and sizing all products as listed in the door hardware sets. Quantities listed are for each pair of doors, or for each single door.

C. Products listed in the Door Hardware Sets must meet the requirements described in the specification sections noted.

1. Section 08 71 00 – Door Hardware.

D. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. MR - Markar
4. RO - Rockwood
5. RU – Corbin Russwin
6. ME - Medeco
7. RF - Rixson
8. LC - LCN
9. VD – Von Duprin
10. HS – HES
11. OT – Others

Hardware Schedule

Set: 1.0

Doors: A101-1, A113-1, A114-1, A203-1, A204-1, A205-1, A206-1, A207-1, A208-1, A209-1, A210-1, A211-1, A211-2, A211-3, A211-4, A218-1, A219-1, M109-1, M114-1, S107-1

3	Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1	Office Lock	ML2051 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100

1	Wall Stop	400	US32D	RO	087100
3	Silencer	608		RO	087100

Set: 2.0

Doors: A102-1

6	Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
2	Flush Bolt	557	US26D	RO	087100
1	Dust Proof Strike	570	US26D	RO	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Surface Overhead Stop	9-X36 5458	689	RF	087100
1	Surface Overhead Stop	9-X36 5459	689	RF	087100
2	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
2	Silencer	608		RO	087100

Set: 3.0

Doors: A111a-1

3	Hinge	T4A3786 x NRP 4-1/2" x 4-1/2"	US26D	MK	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Surface Overhead Stop	9-X36	689	RF	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
3	Silencer	608		RO	087100

Set: 4.0

Doors: A102c-1

3	Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Surface Overhead Stop	9-X36 5458	689	RF	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
3	Silencer	608		RO	087100

Set: 5.0

Doors: A103-1, A104-1, M101-1, A212-1

3	Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100

1	Pull Plate	BF 110x70C	US32D	RO	087100
1	Push Plate	70C	US32D	RO	087100
1	Door Closer	4010 MC	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Wall Stop	400	US32D	RO	087100
3	Silencer	608		RO	087100

Set: 6.0

Doors: A111-1, A112-1, S113-1

3	Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1	Classroom Lock	ML2055 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Door Closer	4010 MC	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Wall Stop	400	US32D	RO	087100
1	Silencer	608		RO	087100

Note: Armor plate at S113-1 in lieu of kickplate.

Set: 7.0

Doors: R-1

3	Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Door Closer	4010 MC	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Wall Stop	400	US32D	RO	087100
1	Gasketing	S773D		PE	087100

Set: 7.1

Doors: S113c-2

3	Hinge	T4A3786 x NRP 4-1/2" x 4-1/2"	US26D	MK	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Door Closer	4110 SCNS MC	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Gasketing	S773D		PE	087100

Set: 8.0

Doors: A106-1, A106a-1

3	Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1	Passage Set	ML2010 NSM	626	RU	087100
1	Door Closer	4010 MC	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Wall Stop	400	US32D	RO	087100
1	Gasketing	S773D		PE	087100
1	Door Bottom	434ARL		PE	087100

Set: 9.0

Doors: A202-1

3	Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1	Classroom Lock	ML2055 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Surface Overhead Stop	9-X36 5458	689	RF	087100
3	Silencers	608		RO	087100

Set: 10.0

Doors: A105-1, A110-1

3	Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1	Classroom Lock	ML2055 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Surface Overhead Stop	9-X36	689	RF	087100
1	Door Closer	4010 MC	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
3	Silencer	608		RO	087100

Set: 11.0

Doors: A115-1

3	Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1	Classroom Lock	ML2055 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100

1	Wall Stop	400	US32D	RO	087100
1	Gasketing	S773D		PE	087100
1	Door Bottom	434ARL		PE	087100

Set: 12.0

Doors: A115a-1, B1-1

6	Hinge	T4A3786 x NRP 4-1/2" x 4-1/2"	US26D	MK	087100
2	Flush Bolt	557	US26D	RO	087100
1	Dust Proof Strike	570	US26D	RO	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Surface Overhead Stop	9-X36 5458	689	RF	087100
1	Surface Overhead Stop	9-X36 5459	689	RF	087100
2	Silencer	608		RO	087100

Set: 13.0

Doors: A102a-1, A102b-1, A111a-1, A118-1, A110a-1, A202a-1, A212a-1, A213-1, A224-1, M102-1, M112c-1, G3-1

3	Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Wall Stop	400	US32D	RO	087100
3	Silencer	608		RO	087100

Note: NRP Hinges at A102a-1 and G3-1.

Set: 14.0

Doors: M130-1

6	Hinge	T4A3786 x NRP 4-1/2" x 4-1/2"	US26D	MK	087100
2	Flush Bolt	555	US26D	RO	087100
1	Dust Proof Strike	570	US26D	RO	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
2	Wall Stop	400	626	RO	087100
1	Door Closer	4110 SCNS MC	689	LC	087100
1	Gasketing	S773D		PE	087100

Set: 15.0

Doors: A220a-1

1	Sliding Door Hdwe	HBP200A/ 5'-4"		PE	087100
1	Sliding Door Hdwe	PF134KIT		PE	087100
2	Flush Pull	BF97	US32D	RO	087100

Set: 16.0

Doors: A225-1, A226-1

3	Hinge	T4A3786 x NRP 4-1/2" x 4-1/2"	US26D	MK	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Surface Overhead Stop	9-X36	689	RF	087100
3	Silencer	608		RO	087100

Set: 17.0

Doors: A-1, A-2, D-1, D-2, D-4, G-1

1	Continuous Hinge	CFM83HD1		PE	087100
1	Exit Device	99L-F BE	US26D	VD	087100
1	Door Closer	4110 EDA MC	689	LC	087100
1	Wall Stop	400	US32D	RO	087100
1	Gasketing	S773D		PE	087100

Notes: Additional gasketing by frame manufacturer where required.

Set: 18.0

Doors: M002-1, M002-2

2	Continuous Hinge	CFM83HD1		PE	087100
2	Flush Bolt	555	US26D	RO	087100
1	Dust Proof Strike	570	US26D	RO	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Surface Overhead Stop	9-X36 5458	689	RF	087100
1	Door Closer	4110 SCNS MC	689	LC	087100
2	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100

2	Silencer	608		RO	087100

Set: 18.1

Doors: S113b-1

2	Continuous Hinge	CFM83HD1		PE	087100
2	Flush Bolt	555	US26D	RO	087100
1	Dust Proof Strike	570	US26D	RO	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
2	Surface Overhead Stop	9-X36 5458	689	RF	087100
1	Door Closer	4010 MC	689	LC	087100
2	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Gasketing	S773D		PE	087100

Set: 19.0

Doors: S113-7, G-3 , M106-2, M107-2, M108-2, M114-2, M115-2, S113-4, S113A-1

1	Continuous Hinge	CFM83HD1		PE	087100
1	Power Transfer	CEPT	US32D	HS	087100
1	Exit Device	ELR 99L-NL	US26D	VD	087100
1	Construction Core	As Specified	626	ME	087100
1	Rim Cylinder Housing	33K076041H	626	ME	087100
1	Power Supply	PS914		VD	087100
1	Door Closer (surface)	4110 SCNS MC	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Threshold	171A		PE	087100
1	Gasketing	2891APK		PE	087100
1	Sweep	18061CNB		PE	087100
1	Card Reader	By Security Contractor		OT	087100
1	Door Position Switch	By Security Contractor		OT	087100
1	Request to Exit Switch	By Security Contractor		OT	087100

Note: Coordinate hardware with Security Contractor.

Set: 19.1

Doors: A108-1

1	Continuous Hinge	CFM83HD1		PE	087100

1	Power Transfer	CEPT	US32D	HS	087100
1	Exit Device	ELR 99NL	US26D	VD	087100
1	Construction Core	As Specified	626	ME	087100
1	Rim Cylinder Housing	33K076041H	626	ME	087100
1	Power Supply	PS914		VD	087100
1	Door Closer (surface)	4110 SCNS MC	689	LC	087100
1	Threshold	171A		PE	087100
1	Gasketing	2891APK		PE	087100
1	Sweep	18061CNB		PE	087100
1	Card Reader	By Security Contractor		OT	087100
1	Door Position Switch	By Security Contractor		OT	087100
1	Request to Exit Switch	By Security Contractor		OT	087100

Note: Coordinate hardware with Security Contractor.

Set: 19.2

Doors: G-1, G2, S113A-3

1	Continuous Hinge	CFM83HD1		PE	087100
1	Exit Device	ELR 99L-NL-F	US26D	VD	087100
1	Construction Core	As Specified	626	ME	087100
1	Rim Cylinder Housing	33K076041H	626	ME	087100
1	Power Transfer	CEPT	US32D	HS	087100
1	Power Supply	PS914		VD	087100
1	Door Closer	4110 EDA MC	689	LC	087100
1	Wall Stop	400	US32D	RO	087100
1	Gasketing	S773D		PE	087100
1	Card Reader	By Security Contractor		OT	087100
1	Door Position Switch	By Security Contractor		OT	087100
1	Request to Exit Switch	By Security Contractor		OT	087100

Note: Coordinate hardware with Security Contractor.

Set: 20.0

Doors: G2-1, M110-1, S105-1

3	Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100

1	Privacy Set	ML2030 NSM	626	RU	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Wall Stop	400	US32D	RO	087100
3	Silencer	608		RO	087100

Set: 21.0

Doors: S102-1, S103-1

1	Continuous Hinge	FM300 7'0	630	MR	087100
1	Classroom Lock	ML2055 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Door Closer	4010 MC SRI	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Wall Stop	400	US32D	RO	087100

Set: 21.1

Doors: S107-1

1	Continuous Hinge	FM300 7'0	630	MR	087100
1	Office Lock	ML2051 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Door Closer	4010 MC SRI	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Wall Stop	400	US32D	RO	087100

Set: 22.0

Doors: M103-1

1	Continuous Hinge	FM300 7'0	630	MR	087100
1	Classroom Lock	ML2055 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Door Closer	4110 SCNS MC SRI	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Threshold	171A		PE	087100
1	Gasketing	2891APK		PE	087100

1	Sweep	18061CNB		PE	087100

Set: 23.0

Doors: M003-3, M006-1

1	Continuous Hinge	CFM83HD1		PE	087100
1	Power Transfer	CEPT	US32D	HS	087100
1	Exit Device	ELR 99L-NL	US26D	VD	087100
1	Construction Core	As Specified	626	ME	087100
1	Rim Cylinder Housing	33K076041H	626	ME	087100
1	Power Supply	PS914		VD	087100
1	Door Closer (surface)	4110 SCNS MC	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Threshold	171A		PE	087100
1	Sweep	18061CNB		PE	087100

Set: 24.0

Doors: D-3, S113-3

1	Continuous Hinge	CFM83HD1		PE	087100
1	Exit Device (exit only)	99 EO	US26D	VD	087100
1	Door Closer (surface)	4110 SCNS MC	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Threshold	171A		PE	087100
1	Gasketing	2891APK		PE	087100
1	Sweep	18061CNB		PE	087100

Set: 24.1

Doors: S113A-2

3	Hinge	T4A3786 x NRP 4-1/2" x 4-1/2"	US26D	MK	087100
1	Exit Device (exit only)	99 L	US26D	VD	087100
1	Construction Core	As Specified	626	ME	087100
1	Rim Cylinder Housing 33K076041H		626	ME	087100
1	Door Closer (surface)	4110 EDA MC	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Wall Stop	400		RO	087100

3	Silencers	608		RO	087100

Set: 25.0

Doors: S100-1, S104-1, S114-1

1	Continuous Hinge	FM300 7'0	630	MR	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Door Closer	4010 MC SRI	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Wall Stop	400	US32D	RO	087100

Set: 25.1

Doors: M112-2

3	Hinge	T4A3786 x NRP 4-1/2" x 4-1/2"	US26D	MK	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Door Closer	4110 SCNS MC	689	LC	087100
1	Armor Plate	K1050 48"	US32D	RO	087100
3	Silencer	608		RO	087100

Set: 25.2

Doors: M105-2, S110-1

3	Hinge	T4A3786 x NRP 4-1/2" x 4-1/2"	US26D	MK	087100
1	Classroom Lock	ML2055 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Door Closer	4110 SCNS MC	689	LC	087100
1	Armor Plate	K1050 48"	US32D	RO	087100
3	Silencer	608		RO	087100

Set: 26.0

Doors: M107-3, M132-1

2	Continuous Hinge	CFM83HD1		PE	087100
2	Flush Bolt	555	US26D	RO	087100
1	Dust Proof Strike	570	US26D	RO	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Door Closer	4110 SCNS MC	689	LC	087100
1	Surface Overhead Stop	9-X36	689	RF	087100
2	Armor Plate	K1050 48" (At M107-3 only)	US32D	RO	087100
2	Silencer	608 (At M107-3 only)		RO	087100
1	Gasketing	S773D		PE	087100

Set: 27.0

Doors: M112-1, M116-1, M114B-2

3	Hinge	T4A3786 NRP 4-1/2" x 4-1/2"	US26D	MK	087100
1	Classroom Lock	ML2055 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Door Closer	4010/4110 MC	689	LC	087100
1	Armor Plate	K1050 48"	US32D	RO	087100
1	Wall Stop	400	US32D	RO	087100
3	Silencer	608		RO	087100

Set: 28.0

Doors: M114B-1

1	Continuous Hinge	CFM83HD1		PE	087100
1	Exit Device	99L	US26D	VD	087100
1	Construction Core	As Specified	626	ME	087100
1	Rim Cylinder Housing	33K076041H	626	ME	087100
1	Door Closer	4110 EDA MC	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Wall Stop	400	US32D	RO	087100
3	Silencer	608		RO	087100

Set: 29.0

Doors: M114C-1

2	Continuous Hinge	CFM83HD1		PE	087100
2	Exit Device	99L BE	US26D	VD	087100
1	Mullion	KR 4954	SP28	VD	087100

2	Door Closer	4110 EDA MC	689	LC	087100
2	Armor Plate	K1050 48"	US32D	RO	087100
2	Wall Stop	400	US32D	RO	087100
2	Silencer	608		RO	087100

Set: 30.0

Doors: M115-1, M117-1

3	Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1	Classroom Lock	ML2055 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Door Closer	4110 SCNS MC	689	LC	087100
1	Armor Plate	K1050 48"	US32D	RO	087100
1	Gasketing	S773D		PE	087100

Set: 31.0

Doors: M118-1

6	Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
2	Flush Bolt	555	US26D	RO	087100
1	Dust Proof Strike	570	US26D	RO	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Surface Overhead Stop	9-X36	689	RF	087100
1	Wall Stop	400	US32D	RO	087100
2	Silencer	608		RO	087100

Set: 32.0

Doors: M121-1

2	Continuous Hinge	CFM83HD1		PE	087100
2	Flush Bolt	555	US26D	RO	087100
1	Dust Proof Strike	570	US26D	RO	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Door Closer	4110 SCNS MC	689	LC	087100
1	Surface Overhead Stop	9-X36	689	RF	087100
2	Silencer	608		RO	087100

Set: 33.0

Doors: M123-1

1	Continuous Hinge	CFM83HD1		PE	087100
1	Classroom Lock	ML2055 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Armor Plate	K1050 48"	US32D	RO	087100
1	Wall Stop	400	US32D	RO	087100
3	Silencer	608		RO	087100

Set: 34.0

Doors: M124-1, M125-1, M126-1, M127-1, M129a-1

1	Continuous Hinge	CFM83HD1		PE	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Kick Plate	K1050 10" x WOD -2"	US32D	RO	087100
1	Wall Stop	400	US32D	RO	087100
3	Silencer	608		RO	087100

Set: 35.0 Not Used

Set: 36.0

Doors: M130-2

1	Continuous Hinge	CFM83HD1		PE	087100
1	Exit Device (exit only)	99EO	US26D	VD	087100
1	Door Closer (surface)	4110 SCNS MC	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Threshold	171A		PE	087100
1	Gasketing	2891APK		PE	087100
1	Sweep	18061CNB		PE	087100

Set: 37.0

Doors: M131-1

1	Continuous Hinge	CFM83SLF-HD1		PE	087100
1	Classroom Lock	ML2055 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Surface Overhead Stop	9-X36	689	RF	087100
1	Door Closer	4010 MC	689	LC	087100

Set: 38.0

Doors: S101-1, S101-2, S111-3

1	Continuous Hinge	FM300 7'0	630	MR	087100
1	Exit Device	99L-F	US26D	VD	087100
1	Construction Core	As Specified	626	ME	087100
1	Rim Cylinder Housing	33K076041H	626	ME	087100
1	Door Closer	4110 SCNS MC SRI	689	LC	087100
1	Door Closer	4110 EDA MC SRI (at S101-2 only)	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Wall Stop	400 (at S101-2 only)	US32D	RO	087100
1	Gasketing	S773D		PE	087100

Set: 39.0

Doors: S106-1, S109-1

3	Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Door Closer	4010 MC	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Wall Stop	400	US32D	RO	087100
1	Gasketing	S773D		PE	087100

Set: 40.0

Doors: G1-1

1	Continuous Hinge	CFM83HD1		PE	087100
1	Office Lock	ML2051 NSM CLS7	626	RU	087100
1	Door Closer (surface)	4110 HSCNS MC	689	LC	087100
1	Threshold	171A		PE	087100
1	Sweep	18061CNB		PE	087100

Note: Balance of weather-strip by aluminum manufacturer.

Set: 41.0

Doors: S108a-1, S108-1, A116-1

3	Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100

1	Electric Strike	1006	630	HS	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Door Closer	4010 MC	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Wall Stop	400	US32D	RO	087100
3	Silencer	608		RO	087100
1	Card Reader	By Security Contractor		OT	087100
1	Door Position Switch	By Security Contractor		OT	087100
1	Request to Exit Switch	By Security Contractor		OT	087100

Note: Power to electric strike by Security Contractor. Coordinate hardware with Security Contractor.

Set: 41.1

Doors: M132-2

3	Hinge	T4A3386 NRP 4-1/2" x 4-1/2"	US32D	MK	087100
1	Electric Strike	1006	630	HS	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Door Closer	4110 SCNS MC	689	LC	087100
1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Threshold	171A		PE	087100
1	Gasketing	2891APK		PE	087100
1	Sweep	18061CNB		PE	087100
1	Card Reader	By Security Contractor		OT	087100
1	Door Position Switch	By Security Contractor		OT	087100
1	Request to Exit Switch	By Security Contractor		OT	087100

Note: Power to electric strike by Security Contractor. Coordinate hardware with Security Contractor.

Set: 42.0

Doors: S108a-1, S113-9

3	Hinge	T4A3786 4-1/2" x 4-1/2"	US26D	MK	087100
1	Electric Strike	1006	630	HS	087100
1	Storeroom Lock	ML2057 NSM CLS7	626	RU	087100
1	Construction Core	As Specified	626	ME	087100
1	Door Closer	4010/4110 MC	689	LC	087100

1	Kick Plate	K1050 10" x WOD -2" B4E	US32D	RO	087100
1	Wall Stop	400	US32D	RO	087100
1	Gasketing	S773D		PE	087100
1	Door Bottom	434ARL		PE	087100
1	Card Reader	By Security Contractor		OT	087100
1	Door Position Switch	By Security Contractor		OT	087100
1	Request to Exit Switch	By Security Contractor		OT	087100

Note: Power to electric strike by Security Contractor. Coordinate hardware with Security Contractor.

Set: 43.0

Doors: A201-1

2	Continuous Hinge	CFM83HD1		PE	087100
1	Power Transfer	CEPT	US32D	HS	087100
1	Exit Device	ELR 99L-NL	US26D	VD	087100
1	Exit Device	99L-DT	US26D	VD	087100
2	Construction Core	As Specified	626	ME	087100
1	Rim Cylinder Housing	33K076041H	626	ME	087100
1	Mortise Cylinder Housing	33K076025	626	ME	087100
1	Mullion	KR 4954	SP28	VD	087100
1	Power Supply	PS914		VD	087100
2	Door Closer	4110 SCNS MC	689	LC	087100
1	Card Reader	By Security Contractor		OT	087100
1	Door Position Switch	By Security Contractor		OT	087100
1	Request to Exit Switch	By Security Contractor		OT	087100

Note: Balance of weather strip by aluminum manufacturer. Coordinate hardware with Security Contractor.

Set: 43.1

Doors: M114A-1

2	Continuous Hinge	CFM83HD1		PE	087100
1	Power Transfer	CEPT	US32D	HS	087100
1	Exit Device	ELR 99L-NL	US26D	VD	087100
1	Exit Device	99L-DT	US26D	VD	087100
2	Construction Core	As Specified	626	ME	087100
1	Rim Cylinder Housing	33K076041H	626	ME	087100
1	Mortise Cylinder Housing	33K076025	626	ME	087100
1	Mullion	KR 4954	SP28	VD	087100

1	Power Supply	PS914		VD	087100
2	Door Closer	4110 SCNS MC	689	LC	087100
1	Threshold	171A		PE	087100
1	Gasketing	2891APK		PE	087100
2	Sweep	18061CNB		PE	087100
1	Card Reader	By Security Contractor		OT	087100
2	Door Position Switch	By Security Contractor		OT	087100
1	Request to Exit Switch	By Security Contractor		OT	087100

Note: Balance of weather strip by aluminum manufacturer. Coordinate hardware with Security Contractor.

Set: 44.0

Doors: A201a-1

2	Continuous Hinge	CFM83HD1		PE	087100
1	Exit Device	99L	US26D	VD	087100
1	Exit Device	99L - DT	US26D	VD	087100
2	Construction Core	As Specified	626	ME	087100
1	Rim Cylinder Housing	33K076041H	626	ME	087100
1	Mortise Cylinder Housing	33K076025	626	ME	087100
1	Mullion	KR 4954	SP28	VD	087100
2	Door Closer	4110 SCNS MC	689	LC	087100
2	Door Bottom	434ARL		PE	087100
1	Threshold	171A		PE	087100

END OF SECTION 080671

SECTION 08 08 00 – COMMISSIONING OF OPENINGS

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Notice to Contractor Sections, apply to this Section. Refer to NOTICE TO CONTRACTOR – COMMISSIONING for a full description of the commissioning process and requirements.

1.2. SUMMARY

A. Commissioning consists of systematically documenting that specified components and systems have been installed and started up properly and then functionally tested to verify and document proper operation through all sequences of operation and conditions. In addition, training of the Owner's Operations Personnel will be verified and final project O&M Documents will be reviewed for completeness.

PART 2 – PRODUCTS

2.1. FUNCTIONAL PERFORMANCE TESTING EQUIPMENT AND INSTRUMENTS

A. Contractor shall provide all tools, instruments, laptop computers, PDA's, software programs and services required to perform system Functional Performance Testing procedures. This includes providing the connection to systems to be tested, operation of the test equipment & instrumentation and generating test results as required.

PART 3 – EXECUTION

3.1. FUNCTIONAL PERFORMANCE TESTING

A. The contractor shall demonstrate to the Engineer and the Cx Authority the performance of the following Building Envelope Systems to the performance level identified.

1. Metal Doors and Frames:

a. System/Equipment to be Tested:

1) Interior and exterior metal doors

b. Functions to be Tested:

1) Refer to ASTM E 783 regarding "Air Infiltration"

c. Conditions of the Test:
    1) Refer to ASTM E 783 regarding “Air Infiltration”

d. Acceptance Criteria:
    1) Refer to ASTM E 783 regarding “Air Infiltration”

2. Aluminum Framed Entrances and Storefronts:

a. System/Equipment to be Tested:
    1) Aluminum doors and frames
    2) Storefront enclosure

b. Functions to be Tested:
    1) Refer to ASTM E 783 regarding “Air Infiltration”
    2) Refer to ASTM E 331 regarding “Water Penetration”

c. Conditions of the Test:
    1) Refer to ASTM E 783 regarding “Air Infiltration”
    2) Refer to ASTM E 331 regarding “Water Penetration”

d. Acceptance Criteria:
    1) Refer to Section 08 41 13 – “Aluminum Framed Entrances and Storefronts” part 1.3

3. Unit Skylight System:

a. System/Equipment to be Tested:
    1) skylights and aluminum flashing

b. Functions to be Tested:
    1) Refer to AAMA 501.2 regarding “Water Testing”

c. Conditions of the Test:
    1) Refer to AAMA 501.2 regarding “Water Testing”

d. Acceptance Criteria:
    1) Refer to AAMA 501.2 regarding “Water Testing” and Section 08 45 13 – “Insulated Skylight System” part 3.4

END OF SECTION 080800

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes hollow-metal work.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4 and 16a-38k-4(b)7.
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 042000 “Unit Masonry Assemblies” for building anchors into and grouting frames.
3. Section 072100 “Thermal Insulation” for insulation placed in exterior door frames.
4. Section 081119 "Stainless-Steel Doors and Frames" for hollow-metal doors and frames manufactured from stainless steel.
5. Section 087100 "Door Hardware" for door hardware.
6. Section 088000 “Glazing” for glass in doors and vision lites.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site

1.6 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

C. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of moldings, removable stops, and glazing.
8. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification:

1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 127 mm).

F. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.7 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Ceco Door Products; an Assa Abloy Group company.
2. Curries Company; an Assa Abloy Group company.
3. Pioneer Industries, Inc.

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY AND PERFORMANCE REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

C. Wind Loads: Determine loads based on the following minimum design wind pressures:
   a. 26.3 psf inward pressure, 28.5 psf outward pressure.

D. Thermal Resistance (U-Factor) for Exterior Doors and Frames: Operable door assembly value of not more than 0.45 when tested according to ASTM C1363.

E. Air Infiltration Exterior Doors and Frames: Maximum air leakage of 0.05 cfm/ sq. ft. when tested according to ASTM E283.

2.3 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:

   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: As indicated in the Door and Frame Schedule.
   c. Face: Uncoated cold-rolled steel sheet, minimum thickness of 0.0478 inch (1.2 mm).
   d. Edge Construction: Model 2, Seamless.
   e. Core: Steel stiffened.

3. Frames:

   a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
   b. Construction: Full profile welded.

4. Exposed Finish: Prime.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Construct exterior frames with thermally broken

C. Doors and Frames: SDI A250.8, Level 3. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:

   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches (44.5 mm.)
   c. Face: Metallic-coated steel sheet, minimum thickness of 0.0598 inch (16 gauge,1.5 mm), with minimum A40 (ZF120) coating.
   d. Edge Construction: Model 2, Seamless.
   e. Core: Polyisocyanurate.

      1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.2 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) when tested according to ASTM C 1363.

3. Frames:

   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.0747 inch (1.9 mm), with minimum A40 (ZF120) coating.
   b. Construction: Thermally broken, full profile welded with min. 3/8 inch thick vinyl, positive thermal break with compression type gasket

4. Exposed Finish: Prime.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable T-shaped anchors to suit frame size, not less than 0.0598 inch (1.5 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.0598 inch (1.5 mm) thick.
3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.0747 inch (1.9 mm), and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.6 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. Glazing: Comply with requirements in Section 088000 "Glazing."

J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Steel-Stiffened Door Cores: Provide minimum thickness 0.099 inch (0.75 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
2. Fire Door Cores: As required to provide fire-protection and temperature-rise ratings indicated.
3. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
4. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
5. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

3. Plaster/ Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
5. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:

        1) Two anchors per jamb up to 60 inches (1524 mm) high.
        2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
        3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
        4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.

    b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

        1) Three anchors per jamb up to 60 inches (1524 mm) high.
        2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
        3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
        4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.

    c. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.

6. Head Anchors: Two anchors per head for frames more than 42 inches (1067 mm) wide and mounted in metal-stud partitions.
7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
4. Provide loose stops and moldings on inside of hollow-metal work.
5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.8 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.9 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. At fire-rated openings, install frames according to NFPA 80.
    b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    c. Install frames with removable stops located on secure side of opening.
    d. Install door silencers in frames before grouting.
    e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
4. Interior Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
5. Exterior Walls andConcrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
6. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:

a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
c. At Bottom of Door: 5/8 inch (15.8 mm) plus or minus 1/32 inch (0.8 mm).
d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

F. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081119 - STAINLESS-STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Stainless-steel, hollow-metal doors.
2. Stainless-steel, hollow-metal frames.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4, 16a-38k-4(b)7.
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 042000 "Unit Masonry" for building anchors into and grouting stainless-steel frames in masonry construction.
3. Section 088000 “Glazing” for glass in doors and vision lites.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.

C. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:

1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 125 mm).
2. Doors: Include section of vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement.
3. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

E. Schedule: Provide a schedule of stainless-steel, hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with a door hardware schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of stainless-steel, hollow-metal door and frame assembly.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain stainless-steel, hollow-metal work from single source from single manufacturer.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

C. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies that are listed and labeled, by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite. Install in compliance with NFPA 80.

D. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Shipping Spreaders: Deliver welded frames with two removable spreader bars across bottom of frames, tack welded or mechanically attached to jambs and mullions.

C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (100-mm-) high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.

1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate installation of anchorages for stainless-steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 STAINLESS-STEEL DOORS AND FRAMES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ceco Door Products; an ASSA ABLOY Group company.
2. CURRIES Company; an ASSA ABLOY Group company.
3. Steelcraft; an Ingersoll-Rand company.

2.2 STAINLESS-STEEL DOORS

A. Description: Stainless-steel doors, not less than 1-3/4 inches (44 mm) thick, of seamless, hollow-metal construction. Construct doors with smooth, flush surfaces without visible joints or seams on faces.

1. Face Sheets: Fabricate from 0.062-inch- (1.59-mm-) thick, stainless-steel sheet.
2. Core Construction: Fabricate doors with core indicated.

a. Welded Steel-Stiffened Core: 0.031-inch- (0.79-mm-) thick, stainless-steel vertical stiffeners extending full-door height, spaced not more than 6 inches (152 mm) apart, spot welded to face sheets a maximum of 5 inches (127 mm) o.c. Fill spaces between stiffeners with mineral-fiber insulation.
b. Fire-Rated Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

3. Vertical Edges for Single-Acting Doors: Beveled 1/8 inch in 2 inches (3 mm in 50 mm).
4. Moldings for Glazed Lites in Doors: 0.038-inch- (0.95-mm-) thick stainless steel.

5. Loose Stops for Glazed Lites in Doors: 0.038-inch- (0.95-mm-) thick stainless steel.
6. Top and Bottom Channels: Closed with continuous channels, 0.062-inch- (1.59-mm-) thick stainless steel.

    a. Spot welded to both face sheets.
    b. Securely fastened using adhesive.

7. Hardware Reinforcement: Fabricate according to ANSI/NAAMM-HMMA 866 with reinforcing plates from stainless steel.

B. Performance: Level A, ANSI A250.4.

C. Materials:

1. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, Type 316.

D. Stainless-Steel Finishes:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

    a. Run grain of directional finishes with long dimension of each piece.
    b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
    c. Directional Satin Finish: No. 4.

2.3 STAINLESS-STEEL PANELS

A. Provide stainless-steel panels of same construction, materials, and finish as specified for adjoining stainless-steel doors.

2.4 STAINLESS-STEEL FRAMES

A. Description: Fabricate stainless-steel frames of construction indicated, with faces of corners mitered and contact edges closed tight.

1. Door Frames: Saw mitered and full (continuously) welded.

    a. Weld frames according to HMMA 820.

2. Borrowed-Light Frames: Machine mitered, faces only welded.
3. Door Frames for Openings 48 Inches (1219 mm) Wide or Less: Fabricate from 0.078-inch- (1.98-mm-) thick, stainless-steel sheet.
4. Door Frames for Openings More Than 48 Inches (1219 mm) Wide: Fabricate from 0.109-inch- (2.78-mm-) thick, stainless-steel sheet.
5. Borrowed-Light Frames: Fabricate from 0.078-inch- (1.98-mm-) thick, stainless-steel sheet.
6. Glazing Stops: Formed integral with stainless-steel frames, minimum 5/8 inch (16 mm) high, unless otherwise indicated.

7. Loose Stops for Glazed Lites: 0.038-inch- (0.95-mm-) thick stainless steel.
8. Hardware Reinforcement: Fabricate according to ANSI/NAAMM-HMMA 866 with reinforcing plates from stainless steel.
9. Head Reinforcement: 0.109-inch- (2.78-mm-) thick, stainless-steel channel or angle stiffener for openings widths more than 48 inches (1219 mm).
10. Jamb Anchors:

    a. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.062-inch- (1.59-mm-) thick stainless steel with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.156 inch (4.0 mm) thick.

11. Floor Anchors: Not less than 0.078-inch- (1.98-mm-) thick stainless steel, and as follows:

    a. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
    b. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.
12. Plaster Guards: Not less than 0.019-inch- (0.48-mm-) thick stainless steel.

B. Performance: Level A, ANSI A250.4.

C. Materials:

1. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, Type 316.

D. Finishes:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

    a. Run grain of directional finishes with long dimension of each piece.
    b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
    c. Directional Satin Finish: No. 4.

2.5 ACCESSORIES

A. Glazing: Comply with requirements in Section 088000 "Glazing."

B. Grout: Comply with ASTM C 476, with a slump of not more than 4 inches (102 mm) as measured according to ASTM C 143/C 143M.

C. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.6 FABRICATION

A. Stainless-Steel Door Fabrication: Stainless-steel doors to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal.

1. Seamless Edge Construction: Door face sheets joined at vertical edges by continuous weld extending full height of door; with edges ground and polished, providing smooth, flush surfaces with no visible seams.
2. Stops and Moldings: Factory cut openings in doors. Provide stops and moldings around glazed lites. Form corners of stops and moldings with butted or mitered hairline joints.

    a. Glazed Lites: Provide fixed stops and moldings welded on secure side of door.
    b. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

3. Hardware Preparation: Factory prepare stainless-steel doors to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 087100 "Door Hardware."

    a. Reinforce doors to receive nontemplated mortised and surface-mounted door hardware.

4. Locate hardware as indicated, or if not indicated, according to HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."
5. Tolerances: Fabricate doors to tolerances indicated in ANSI/NAAMM-HMMA 866.

B. Stainless-Steel Frame Fabrication: Fabricate stainless-steel frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

1. Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated from same thickness metal as frames.

2. Provide countersunk, flat-, or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
4. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
        1) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) in height.

5. Head Reinforcement: For frames more than 48 inches (1219 mm) wide, provide continuous head reinforcement for full width of opening, welded to back of frame at head.
6. Door Silencers: Drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

7. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

    a. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of door or frame.
    b. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

8. Hardware Preparation: Factory prepare stainless-steel frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 087100 "Door Hardware."

    a. Reinforce frames to receive nontemplated mortised and surface-mounted door hardware.
    b. Locate hardware as indicated, or if not indicated, according to HMMA 831, "Recommended Hardware Locations for Custom Hollow Metal Doors and Frames."

9. Plaster Guards: Weld guards to frame at back of hardware mortises and mounting holes in frames to be grouted.
10. Tolerances: Fabricate frames to tolerances indicated in ANSI/NAAMM-HMMA 866.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stainless-steel doors and frames.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of stainless-steel, door-frame connections before frame installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation and with installation spreaders in place, adjust and securely brace stainless-steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install stainless-steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with ANSI/NAAMM-HMMA 866 and manufacturer's written instructions.

B. Stainless-Steel Frames: Install stainless-steel frames of size and profile indicated.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. At fire-protection-rated openings, install frames according to NFPA 80.
    b. Install frames with removable glazing stops located on secure side of opening.
    c. Install door silencers in frames before grouting.
    d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    e. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    f. Apply corrosion-resistant coating to backs of grout-filled frames.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.
3. Grouted Frames: Solidly fill space between frames and substrate with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
4. Installation Tolerances: Adjust stainless-steel frames for squareness, alignment, twist, and plumb to the following tolerances:

a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Stainless-Steel Doors: Fit non-fire-rated doors accurately in frames with the following clearances:

1. Non-Fire-Rated Doors:

a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Glazing: Install glazing in sidelights, transoms, and borrowed lights to comply with installation requirements in Section 088000 "Glazing."

1. Secure stops with countersunk, flat-, or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c., and not more than 2 inches (50 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work including stainless-steel doors or frames that are warped, bowed, or otherwise unacceptable.

B. Clean grout and other bonding material off stainless-steel doors and frames immediately after installation.

C. Stainless-Steel Touchup: Immediately after erection, smooth any abraded areas of stainless steel and polish to match undamaged finish.

END OF SECTION 081119

SECTION 081216 - ALUMINUM FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes interior aluminum frames for doors installed in gypsum board partitions.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4, 16a-38k-4(b)5 and 16a-38k-4(d)9
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.
2. Section 081416 "Flush Wood Doors" for wood doors installed in interior aluminum frames.
3. Section 084113 "Aluminum-Framed Entrances and Storefronts" for aluminum-framed glass doors installed in interior aluminum frames.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, fire-resistance rating, and finishes.

C. Shop Drawings: Include the following:

1. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
2. Locations of reinforcements and preparations for hardware.
3. Details of each different wall-opening condition.
4. Details of anchorages, joints, field splices, and connections.
5. Details of accessories.
6. Details of moldings, removable stops, and glazing.
7. Details of conduits and preparations for power, signal, and control systems.

D. Samples for Initial Selection: For units with factory-applied finishes.

1. Include similar Samples of seals, gaskets, and accessories involving color selection.

E. Samples for Verification: For interior aluminum frames, prepared on Samples of size indicated below:

1. Framing Member: 12 inches (300 mm) long.
2. Corner Fabrication: 12-by-12-inch- (300-by-300-mm-) long, full-size window corner, including full-size sections of extrusions with factory-applied color finish.

F. Schedule: For interior aluminum frames. Use same designations indicated on Drawings**.** Coordinate with door hardware schedule and glazing.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of interior aluminum frame.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Aluminum Frames to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain interior aluminum frames from single source from single manufacturer.

B. Fire-Rated Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver interior aluminum frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic. Store interior aluminum frames under cover at Project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advanced Architectural Frames.
2. Interior Components Inc.
3. Wilson Partitions.

2.2 COMPONENTS

A. Aluminum Framing: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 or alloy and temper required to suit structural and finish requirements, not less than 0.062 inch (1.6 mm) thick.

B. Door Frames: Extruded aluminum, reinforced for hinges, strikes, and closers.

C. Glazing Frames: Extruded aluminum, for glazing thickness indicated.

D. Trim: Extruded aluminum, not less than 0.062 inch (1.6 mm) thick, with removable snap-in casing trim, glazing stops and door stops without exposed fasteners.

1. Trim Style: As selected by Architect from manufacturer’s full range.

2.3 ACCESSORIES

A. Fasteners: Aluminum, nonmagnetic, stainless-steel or other noncorrosive metal fasteners compatible with frames, stops, panels, reinforcement plates, hardware, anchors, and other items being fastened.

B. Door Silencers: Manufacturer's standard continuous mohair, wool pile, or vinyl seals.
1. Color and Gloss: As selected by Architect from manufacturer's full range.

C. Smoke Seals: Intumescent strip or fire-rated gaskets.

D. Color and Gloss: As selected by Architect from manufacturer's full range.Glazing Gaskets: Manufacturer's standard extruded or molded plastic, to accommodate glazing thickness indicated.
1. Color and Gloss: As selected by Architect from manufacturer's full range.

E. Glazing: Comply with requirements in Section 088000 "Glazing."

F. Hardware: Comply with requirements in Section 087100 "Door Hardware".

2.4 FABRICATION

A. Provide concealed corner reinforcements and alignment clips for accurately fitted hairline joints at butted or mitered connections.

B. Factory prepare interior aluminum frames to receive templated mortised hardware; include cutouts, reinforcements, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 087100 "Door Hardware."

   1. Locate hardware as required by fire-rated label for assembly.

C. Fabricate frames for glazing with removable stops to allow glazing replacement without dismantling frame.

   1. Locate removable stops on the inside of spaces accessed by keyed doors.

D. Fabricate components to allow secure installation without exposed fasteners.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and ceilings, with Installer present, for conditions affecting performance of the Work.

B. Verify that wall thickness does not exceed standard tolerances allowed by throat size indicated.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install interior aluminum frames plumb, rigid, properly aligned, and securely fastened in place; comply with manufacturer's written instructions.

B. Set frames accurately in position and plumbed, aligned, and securely anchored to substrates.

1. At fire-protection-rated openings, install interior aluminum frames according to NFPA 80.

C. Install frame components in the longest possible lengths; components up to 96 inches (2450 mm) long must be one piece.
1. Use concealed installation clips to produce tightly fitted and aligned splices and connections.
2. Secure clips to extruded main-frame components and not to snap-in or trim members.
3. Do not leave screws or other fasteners exposed to view when installation is complete.

3.3 CLEANING

A. Clean exposed frame surfaces promptly after installation, using cleaning methods recommended by frame manufacturer and according to AAMA 609 & 610.

B. Touch up marred frame surfaces so touchup is not visible.. Remove and replace frames with damaged finish that cannot be satisfactorily repaired.

END OF SECTION 081216

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-4(d)13 and 16a-38k-4(b)7
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.
2. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications**.**

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.

6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

D. Samples for Initial Selection: For factory-finished doors.

E. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish**.** For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
2. Corner sections of doors, approximately 8 by 10 inches (200 by 250 mm), with door faces and edges representing actual materials to be used.

   a. Provide Samples for each species of veneer and solid lumber required.
   b. Finish veneer-faced door Samples with same materials proposed for factory-finished doors.

3. Louver blade and frame sections, 6 inches (150 mm) long, for each material and finish specified.
4. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.6 CLOSEOUT SUBMITTALS

A. Warranty: For Flush Wood Doors specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is a certified participant in AWI's Quality Certification Program.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 percent during remainder of construction period.

1.10 WARRANTY

A. A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm) section.
b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a 76.2-mm) span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eggers Industries.
2. Graham Wood Doors; an Assa Abloy Group company.
3. Mohawk Doors; a Masonite company.

B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.
2. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.

B. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
3. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
4. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

D. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde.
2. Blocking: Provide wood blocking in particleboard-core doors asneeded to eliminate through-bolting hardware.
3. Provide doors with structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

E. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.

   a. Screw Withdrawal, Face: 700 lbf (3100 N).
   b. Screw Withdrawal, Edge: 400 lbf (1780 N).

F. Mineral-Core Doors:

1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors :

1. Grade: Premium, with Grade A faces.
2. Species: White Maple.
3. Cut: Plain sliced (flat sliced).

4. Match between Veneer Leaves: Book match.
5. Assembly of Veneer Leaves on Door Faces: Balance match.
6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
7. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 20 feet (6 m) or more.
8. Exposed Vertical and Top Edges: Same species as faces.
9. Core: Particleboard or Structural composite lumber.
10. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.
11. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

2.4 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Flush rectangular beads.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.6 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.

B. Factory finish doors that are indicated to receive transparent finish.

C. Transparent Finish:

1. Grade: Custom.
2. Finish: AWI's, "Architectural Woodwork Standards" System 5, conversion varnish or System 11, catalyzed polyurethane.
3. Staining: Custom color to match, Formica; 6206-43 Planked Deluxe Pear..
4. Effect: Open-grain finish.
5. Sheen: Satin or Semigloss, as selected by Architect..

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware".

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.

C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Access doors and frames for walls and ceilings.
2. Exterior doors and frames for weather resistant applications.

B. Related Requirements:

1. Section 077200 "Roof Accessories" for roof hatches.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details**,** fire ratings, materials, individual components and profiles, and finishes.

C. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Detail fabrication and installation of access doors and frames for each type of substrate.

D. Samples: For each door face material, at least 3 by 5 inches (75 by 125 mm) in size, in specified finish.

E. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Babcock-Davis.
2. Karp Associates, Inc.
3. Larsen's Manufacturing Company.

B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

C. Flush Access Doors with Exposed Flanges :

1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
2. Locations: Masonry or ceramic tile surfaces..
3. Door Size: As indicated on drawings.
4. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage.

   a. Finish: Factory prime.

5. Frame Material: Same material, thickness, and finish as door.
6. Hinges: Manufacturer's standard.
7. Hardware: Lock.

D. Recessed Access Doors

1. Assembly Description: Fabricate door in the form of a pan recessed 5/8 inch (16 mm) for gypsum board infill. Provide frame with gypsum board bead for concealed flange installation.
2. Locations: Gypsum board walls and ceilings.
3. Door Size: As indicated on drawings.
4. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage.

   a. Finish: Factory prime.

5. Frame Material: Same material and thickness as door.

6. Hinges: Manufacturer's standard.
7. Hardware: Lock.

E. Exterior Flush Access Doors :

1. Basis-of-Design Product: Subject to compliance with requirements, provide XTL Series; Nystrom Inc..
2. Assembly Description: Fabricate door to be weatherproof and fit flush to frame. Provide manufacturer's standard 2-inch- (50-mm-) thick fiberglass insulation and extruded door gaskets. Provide manufacturer's standard-width frame for surface mounting, proportional to door size.
3. Locations: Underside of Bridge.
4. Door Size: As indicated on drawings.
5. Galvannealed Steel Sheet for Door: 20 gage.

    a. Finish: Factory finish.

6. Frame Material: Extruded aluminum, manufacturers standard thickness..
7. Hinges: Stainless steel piano hinge.
8. Hardware: Latch, key operated, chrome plated steel, lockable from exterior.

F. Fire-Rated, Flush Access Doors with Exposed Flanges :

1. Assembly Description: Fabricate door to fit flush to frame, uninsulated. Provide self-latching door with automatic closer and interior latch release. Provide manufacturer's standard-width exposed flange, proportional to door size.
2. Locations: Masonry or ceramic tile surfaces.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Uncoated Steel Sheet for Door: Nominal 0.036 inch (0.91 mm), 20 gage.

    a. Finish: Factory prime.

5. Frame Material: Same material, thickness, and finish as door.
6. Hinges: Manufacturer's standard.
7. Hardware: Lock.

G. Fire-Rated, Flush Access Doors with Concealed Flanges :

1. Assembly Description: Fabricate door to fit flush to frame, uninsulated. Provide self-latching door with automatic closer and interior latch release. Provide frame with gypsum board beads for concealed flange installation.
2. Locations: Gypsum board walls and ceilings. .
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Uncoated Steel Sheet for Door: Nominal 0.036 inch (0.91 mm), 20 gage.

    a. Finish: Factory prime.

5. Frame Material: Same material, thickness, and finish as door.
6. Hinges: Manufacturer's standard.
7. Hardware: Lock.

H. Hardware:

1. Lock: Cylinder.

2.3 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

D. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

E. Frame Anchors: Same type as door face.

F. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.4 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
2. Provide mounting holes in frames for attachment of units to metal or wood framing.
3. Provide mounting holes in frame for attachment of masonry anchors.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.

E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

1. For cylinder locks, furnish two keys per lock and key all locks alike.
2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

2.5 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Steel and Metallic-Coated-Steel Finishes:

1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
2. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of 1 mil (0.025 mm) for topcoat.

    a. Color: Custom color as chosen by architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.
B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 083313 - COILING COUNTER DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire-rated counter doors.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)5
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type and size of coiling counter door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
3. Include description of automatic closing device and testing and resetting instructions.

C. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.

4. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
5. Include diagrams for power, signal, and control wiring.

D. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1. Include similar Samples of accessories involving color selection.

E. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1. Curtain slats.
2. Bottom bar.
3. Guides.
4. Brackets.
5. Hood.
6. Include similar Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Coiling Counter Doors to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252or UL 10B.

1. Temperature-Rise Limit: Provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain coiling counter door from single source from single manufacturer.

1. Obtain operators and controls from coiling counter door manufacturer.

2.2 COUNTER DOOR ASSEMBLY (NON FIRE-RATED)

A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cookson Company.
   b. Cornell Iron Works, Inc.
   c. Overhead Door Corporation.

B. Operation Cycles: Door components and operators capable of operating for not less than 10,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1. Include tamperproof cycle counter.

C. Door Curtain Material: Stainless steel.

D. Door Curtain Slats: Flat profile slats of 1-1/4-inch (32-mm) center-to-center height.

E. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated stainless steel and finished to match door.

F. Curtain Jamb Guides: Stainless steel with exposed finish matching curtain slats.

G. Hood: Stainless steel.

1. Shape: Square.
2. Mounting: Face of wall.

H. Locking Devices: Equip door with slide bolt for padlock.

I. Manual Door Operator: Push-up operation.

J. Curtain Accessories: Equip door with push/pull handles and pull down strap.

K. Door Finish:
1. Stainless-Steel Finish: No. 4 (polished directional satin).

2.3 FIRE-RATED COUNTER DOOR ASSEMBLY

A. Fire-Rated Counter Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cookson Company.
   b. Cornell Iron Works, Inc.
   c. Overhead Door Corporation.

B. Operation Cycles: Door components and operators capable of operating for not less than 10,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1. Include tamperproof cycle counter.

C. Fire Rating: 1 hour.

D. Door Curtain Material: Stainless steel.

E. Door Curtain Slats: Flat profile slats of 1-1/4-inch (32-mm) center-to-center height.

1. Insulated-Slat Interior Facing: Metal.

F. Curtain Jamb Guides: Stainless steel with exposed finish matching curtain slats.

G. Hood: Stainless steel.

1. Shape: Square.
2. Mounting: Face of wall.

H. Sill Configuration: 14 gauge stainless steel, no.4 finish..

I. Manual Door Operator: Push-up operation.

J. Curtain Accessories: Equip door with smoke seals, automatic closing device, push/pull handles.

K. Door Finish:
1. Stainless-Steel Finish: No. 4 (polished directional satin).

2.4 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate coiling counter-door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Stainless-Steel Door Curtain Slats: ASTM A 666, Type 304; sheet thickness of 0.025 inch (0.64 mm); and as required.
2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

1. Removable Posts and Jamb Guides: Manufacturer's standard.

2.5 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Stainless Steel: 0.025-inch- (0.64-mm-) thick stainless-steel sheet, Type 304, complying with ASTM A 666.
2. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.

2.6 CURTAIN ACCESSORIES

A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.

B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

C. Automatic-Closing Device: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism Automatic-closing device shall be designed for activation by the following:

1. Replaceable fusible links with temperature rise and melting point of 165 deg F (74 deg C) interconnected and mounted on both sides of door opening.

2.7 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic closing device operates.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.8 MANUAL DOOR OPERATORS

A. General: Equip door with manual door operator by door manufacturer.

B. Push-up Door Operation: Design counterbalance mechanism so that required lift or pull for door operation does not exceed 25 lbf (111 N).

2.9 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.10 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install coiling counter doors, hoods, controls, and operators at the mounting locations indicated for each door.

C. Fire-Rated Doors: Install according to NFPA 80.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

END OF SECTION 083313

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Service doors.
2. Fire-rated service doors.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)5
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed

2. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type and size of overhead coiling door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
3. Include description of automatic closing device and testing and resetting instructions.

C. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.

4. For exterior bus wash door components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture.
5. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
6. Include diagrams for power, signal, and control wiring.

D. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1. Include similar Samples of accessories involving color selection.

E. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1. Curtain slats, including full vision window secured to slat.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Overhead Coiling Doors to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.

C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Windstorm Pressure Resistance: 30 psf plus 1.5 safety factor yielding an ultimate windstorm pressure resistance of 45psf.
2. Lateral Pressures: 26.3 psf inward pressure, 28.5 psf outward pressure.
3. Testing: According to ASTM E 330.
4. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
5. Operability under Wind Load: Design overhead coiling doors to remain operable under uniform pressure (velocity pressure) of 20 lbf/sq. ft. (960 Pa) wind load, acting inward and outward.

2.3 DOOR ASSEMBLY

A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cookson Company.
b. Cornell Iron Works, Inc.
c. Overhead Door Corporation.

B. Operation Cycles: Door components and operators capable of operating for not less than 100,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1. Include tamperproof cycle counter.

C. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. (0.406 L/s per sq. m) at 15 and 25 mph (24.1 and 40.2 km/h) when tested according to ASTM E 283.

D. Curtain R-Value: 6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W).

E. Door Curtain Material: Galvanized steel.

F. Door Curtain Slats: Flat profile slats of 1-7/8-inch (48-mm) center-to-center height.

1. Vision Panels: Approximately 10- by 1-5/8-inch (254- by 41-mm) openings spaced approximately 2 inches (51 mm) apart and beginning 12 inches (305 mm) from end guides; in three rows of slats at height indicated on Drawings; installed with vision-panel glazing.
2. Insulated-Slat Interior Facing: Metal.
3. Gasket Seal. Manufacturer's standard continuous gaskets between slats.

G. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; fabricated from hot-dip galvanized steel and finished to match door.

H. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

I. Hood: Galvanized steel.

1. Shape: Square.
2. Mounting: Face of wall.

J. Locking Devices: Equip door with slide bolt for padlock.

K. Electric Door Operator:

1. Usage Classification: Heavy duty, 25 or more cycles per hour and over 90 cycles per day.
2. Operator Location: Wall.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
4. Motor Exposure: Interior.
5. Emergency Manual Operation: Chain type.
6. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar
7. Control Station(s): Each side of opening with priority to first operated.

L. Door Finish:
1. Baked-Enamel or Powder-Coated Finish: Custom color as selected by Architect from manufacturer's full range.
2. Factory Prime Finish: Manufacturer's standard color.
3. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.4 FIRE-RATED DOOR ASSEMBLY

A. Fire-Rated Service Door: Overhead fire-rated coiling door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cookson Company.
   b. Cornell Iron Works, Inc.
   c. Overhead Door Corporation.

B. Operation Cycles: Door components and operators capable of operating for not less than 100,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1. Include tamperproof cycle counter.

C. Fire Rating: As indicated on the drawings .

D. Door Curtain Material: Galvanized steel.

E. Door Curtain Slats: Flatprofile slats of 1-7/8-inch (48-mm) center-to-center height.

1. Vision Panels: Approximately 10- by 1-5/8-inch (254- by 41-mm) openings spaced approximately 2 inches (51 mm) apart and beginning 12 inches (305 mm) from end guides; in three rows of slats at height indicated on Drawings; installed with fire-rated vision-panel glazing.

F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

G. Hood: Galvanized steel.

1. Shape: Square.
2. Mounting: Face of wall.

H. Electric Door Operator:

1. Usage Classification: Heavy duty, 25 or more cycles per hour and over 90 cycles per day.
2. Operator Location: Wall.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
4. Motor Exposure: Interior and Exterior, wet, and humid at Bus Wash.
5. Emergency Manual Operation: Chain type.
6. Obstruction Detection Device: Automatic electric sensor edge on bottom bar.
7. Control Station(s): Each side of opening with priority to first operated.

I. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Custom color as selected by Architect from manufacturer's full range.
2. Factory Prime Finish: Manufacturer's standard color.
3. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face .

2.5 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.6 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm); and as required.
2. Vision-Panel Glazing: Manufacturer's standard clear glazing, fabricated from transparent acrylic sheet or fire-protection rated glass as required for type of door; set in glazing channel secured to curtain slats.
3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.028 inch (0.71 mm).

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.7 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
2. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.
3. Bus Wash-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

2.8 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.9 CURTAIN ACCESSORIES

A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.

B. Weatherseals for Bus Wash and Exterior Doors: Equip each Bus Wash and exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

1. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.
2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene.

C. Automatic-Closing Device for Fire-Rated Doors: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism. Release mechanism for motor- operated doors shall allow testing without mechanical release of the door. Automatic-closing device shall be designed for activation by the following:

1. Replaceable fusible links with temperature rise and melting point of 165 deg F (74 deg C) interconnected and mounted on both sides of door opening.

2.10 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

1. Fire-Rated Doors: Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic closing device operates.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.11 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): Operator location indicated for each door.

1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.
2. Front-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.
3. Wall Mounted: Operator is mounted to the inside front wall on the left or right side of door and connected to door drive shaft with drive chain and sprockets. Side room is required for this type of mounting. Wall mounted operator can also be mounted above or below shaft; if above shaft, headroom is required.
4. Bench Mounted: Operator is mounted to the right or left door head plate and connected to the door drive shaft with drive chain and sprockets. Side room is required for this type of mounting.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.

1. Electrical Characteristics:

   a. Phase: Single phase.
   b. Volts: 115 V.
   c. Hertz: 60.

2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
3. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel. For fire-rated doors, activation delays closing.

1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.

2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

a. Self-Monitoring Type: Four-wire configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.

3. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device.

G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
2. Bus Wash and Exterior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.12 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.13 STEEL AND GALVANIZED-STEEL FINISHES

A. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Fire-Rated Doors: Install according to NFPA 80.

E. Power-Operated Doors: Install automatic garage doors openers according to UL 325.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

   1. Adjust exterior doors and components to be weather-resistant.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

   1. Perform maintenance, including emergency callback service, during normal working hours.
   2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTION 083463 - DETENTION DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Swinging detention doors.
2. Detention frames.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4 and 16a-38k-4(d)9
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 DEFINITIONS

A. Minimum-Thickness Steel: Indicated as the specified minimum thicknesses for base metal without coatings, according to NAAMM-HMMA 803.

B. Nominal-Thickness Stainless Steel: Indicated as the specified thicknesses for which over- and under-thickness tolerances apply, according to ASTM A 480/A 480M.

1.4 COORDINATION

A. Coordinate anchorage installation for detention frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors that are to be embedded in adjacent construction. Deliver such items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, label compliance, and finishes for each detention door and frame type specified.

C. Shop Drawings: In addition to requirements below, provide a schedule using same reference numbers for details and openings as those on Drawings:

1. Elevations of each door type.
2. Direction of swing.
3. Details of doors, including vertical and horizontal edge details, and metal thicknesses.
4. Details of frames, including dimensioned profiles, and metal thicknesses.
5. Locations of reinforcement and preparations for hardware.
6. Details of each different wall opening condition.
7. Details of anchorages, joints, field splices, and connections.
8. Details of moldings, removable stops, and glazing.

D. Samples for Verification:

1. For each type of exposed finish required, prepare Samples not less than 3 by 5 inches (76 by 127 mm).
2. For "Detention Doors" and "Detention Frames" subparagraphs below, prepare Samples approximately 12 by 12 inches (305 by 305 mm) to demonstrate compliance with requirements for quality of materials and construction:

   a. Detention Doors: Show vertical-edge, top, and bottom construction; insulation; face stiffeners; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
   b. Detention Frames: Show profile, welded corner joint, welded hinge reinforcement, grout-cover boxes, floor and wall anchors, and silencers. Include separate section showing fixed steel panels and glazing if applicable.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.

C. Product Test Reports: For each type of detention hollow-metal door and frame assembly including vision and side lights, for tests performed by a qualified testing agency.

D. Examination reports documenting inspection of substrates, areas, and conditions.

E. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

F. Field quality-control reports documenting inspections of installed products.

1. Field quality-control certification signed by Contractor.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Security Fasteners: Furnish not less than one box for every 50 boxes or fraction thereof, of each type and size of security fastener installed.
2. Tools: Provide two sets of tools for installing and removing security fasteners.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver detention hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded detention frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store detention hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6.3-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ceco Door Products; an ASSA ABLOY Group company.
2. Pioneer Industries, Inc.
3. Trussbilt; an ASSA ABLOY Group company.

B. Source Limitations: Obtain detention doors and frames from single source from single manufacturer.

2.2 DETENTION DOOR AND FRAME ASSEMBLIES

A. Detention Door and Frame Assemblies: Provide detention door and frame assemblies that comply with the following, based on testing manufacturer's standard units in assemblies similar to those indicated for this Project:

1. Security Grade: Assemblies pass testing requirements in ASTM F 1450 for security grades specified.
2. Bullet Resistance: Level 3 rated when tested according to UL 752.
3. Tool-Attack Resistance: Small-tool-attack-resistance rated when tested according to UL 437 and UL 1034.

B. Detention Frames: Provide sidelight and borrowed-light detention frames that comply with ASTM F 1592 and removable stop test according to NAAMM-HMMA 863, based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.

2.3 DETENTION DOORS

A. General: Provide flush-design detention doors of seamless hollow construction, 2 inches (51 mm) thick unless otherwise indicated. Construct detention doors with smooth, flush surfaces without visible joints or seams on exposed faces or stile edges.

1. For single-acting swinging detention doors, bevel both vertical edges 1/8 inch in 2 inches (3 mm in 51 mm).

B. Core Construction: Provide the following core construction of same material as detention door face sheets, welded to both detention door faces:

1. Steel-Stiffened Core: 0.042-inch- (1.0-mm-) thick, steel vertical stiffeners extending full-door height, with vertical webs spaced not more than 4 inches (102 mm) apart, spot welded to face sheets a maximum of 3 inches (76 mm) o.c. Fill spaces between stiffeners with insulation.
2. Truss-Stiffened Core: 0.013-inch- (0.3-mm-) thick, steel, truncated triangular stiffeners extending between face sheets and for full height and width of door; with stiffeners welded to face sheets not more than 3 inches (76 mm) o.c. vertically and 2-3/4 inches (70 mm) horizontally. Fill spaces between stiffeners with insulation.

C. Vertical Edge Channels: 0.123-inch- (3.1-mm-) thick, continuous channel of same material as detention door face sheets, extending full-door height at each vertical edge; welded to top and bottom channels to create a fully welded perimeter channel. Noncontiguous channel is permitted to accommodate lock-edge hardware only if lock reinforcement is welded to and made integral with channel.

D. Top and Bottom Channels: 0.123-inch- (3.1-mm-) thick metal channel of same material as detention door face sheets, spot welded, not more than 4 inches (102 mm) o.c., to face sheets.

1. Reinforce top edge of detention door with 0.053-inch- (1.3-mm-) thick closing channel, welded so channel web is flush with top door edges.

E. Hardware Reinforcement: Fabricate reinforcing plates from same material as detention door face sheets to comply with the following minimum thicknesses:

1. Full-Mortise Hinges and Pivots: 0.187 inch (4.7 mm) thick.
2. Maximum-Security Surface Hinges: 0.250 inch (6.3 mm) thick.
3. Strike Reinforcements: 0.187 inch (4.7 mm) thick.
4. Slide-Device Hanger Attachments: As recommended by device manufacturer.
5. Lock Fronts, Concealed Holders, and Surface-Mounted Closers: 0.093 inch (2.3 mm) thick.
6. All Other Surface-Mounted Hardware: 0.093 inch (2.3 mm) thick.
7. Lock Pockets: 0.123 inch (3.1 mm) thick at non-inmate side, welded to face sheet.

F. Hardware Enclosures: Provide enclosures and junction boxes for electrically operated detention door hardware of same material as detention door face sheets, interconnected with UL-approved, 1/2-inch- (12.7-mm-) diameter conduit and connectors.

1. Access Plates: Where indicated for wiring installation, provide access plates to junction boxes, fabricated from same material and thickness as face sheet and fastened with at least four security fasteners spaced not more than 6 inches (152 mm) o.c.

G. Interior Detention Doors: Construct interior doors to comply with materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances indicated in NAAMM-HMMA 863 and as specified.
1. Security Grade 3: Provide doors with face sheets of 0.078-inch (2.0-mm) nominal-thickness stainless steel.

2.4 DETENTION FRAMES

A. General: Provide fully welded detention frames with integral stops, of seamless construction without visible joints or seams. Fabricate detention frames with contact edges closed tight and corners mitered, reinforced, and continuously welded full depth and width of detention frame.

B. Stop Height: Provide minimum stop height of 0.625 inch (16 mm) for detention door openings and minimum stop height of 1-1/4 inches (32 mm) in security glazing or detention panel openings unless otherwise indicated.

C. Interior Detention Frames: Construct interior frames to comply with materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances indicated in NAAMM-HMMA 863 and as specified.
1. Security Grade 3: Provide frames fabricated from 0.078-inch (2.0-mm) nominal-thickness stainless steel.

D. Hardware Reinforcement: Fabricate reinforcing plates from same material as detention frame to comply with the following minimum thicknesses:

1. Hinges and Pivots: 0.187 inch (4.7 mm) thick by 1-1/2 inches (38 mm) wide by 10 inches (254 mm) long.

2. Strikes and Closers: 0.187 inch (4.7 mm) thick.
3. Surface-Mounted Hardware: 0.093 inch (2.3 mm) thick.
4. Lock Pockets: 0.123 inch (3.1 mm) thick at non-inmate side, welded to face sheet. Provide 0.123-inch- (3.1-mm-) thick, lock protection plate for attachment to lock pocket with security fasteners.

E. Jamb Anchors: Weld jamb anchors to detention frames near hinges and directly opposite on strike jamb or as required to secure detention frames to adjacent construction.

1. Number of Anchors: Provide two anchors per jamb plus the following:

a. Detention Door Frames: One additional anchor for each 18 inches (457 mm), or fraction thereof, above 54 inches (1372 mm) in height.

2. Masonry Anchors: Adjustable, corrugated or perforated, strap-and-stirrup anchors to suit detention frame size; formed of same material and thickness as detention frame; with strap not less than 2 inches (51 mm) wide by 10 inches (254 mm) long.

3. Postinstalled Anchors: Minimum 1/2-inch- (12.7-mm-) diameter concealed bolts with expansion shields or inserts. Provide conduit spacer from detention frame to wall, welded to detention frame. Reinforce detention frames at anchor locations.

F. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, formed of same material and thickness as detention frame, and as follows:

1. Monolithic Concrete Slabs: Clip anchors, with two holes to receive fasteners, welded to bottom of jambs and mullions with at least four spot welds per anchor.
2. Separate Topping Concrete Slabs: Adjustable anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment, welded to jambs and mullions with at least four spot welds per anchor. Terminate bottom of detention frames at finish floor surface.

G. Rubber Door Silencers: Except on weather-stripped detention doors, drill stops in strike jambs to receive three silencers on single-detention-door frames and drill head jamb stop to receive two silencers on double-detention-door frames. Keep holes clear during construction.

H. Grout Guards: Provide factory-installed grout guards of same material as detention frame, welded to detention frame at back of hardware cutouts, silencers, and glazing-stop screw preparations to close off interior of openings and prevent mortar or other materials from obstructing hardware operation or installation.

2.5 MOLDINGS AND STOPS

A. Provide fixed moldings on non-secure side of glazed openings and removable stops on non-inmate side.

1. Height: As required to provide minimum 1-inch (25-mm) glass engagement, but not less than 1-1/4 inches (32 mm).
2. Fixed Moldings: Formed from same material as detention door and frame face sheets, but not less than 0.093 inch (2.3 mm) thick, and spot welded to face sheets a maximum of 5 inches (127 mm) o.c.

3. Removable Stops: Formed from 0.123-inch- (3.1-mm-) thick angle, of same material as detention door face sheets. Secure with button head security fasteners spaced uniformly not more than 9 inches (229 mm) o.c. and not more than 2 inches (51 mm) from each corner, and as necessary to satisfy performance requirements. Form corners with notched or mitered hairline joints.

B. Coordinate rabbet width between fixed and removable stops with glass or panel type and installation type indicated.

2.6 MATERIALS

A. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS (Commercial Steel), Type B.

C. Stainless-Steel Sheet: ASTM A 240/A 240M, austenitic stainless steel, Type 304.

D. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

E. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.

F. Masonry Anchors: Fabricated from same steel sheet as door face.

G. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

H. Glazing: Comply with Section 088853 "Security Glazing."

I. Grout: Comply with ASTM C 476, with a slump of not more than 4 inches (102 mm) as measured according to ASTM C 143/C 143M.

J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 FABRICATION

A. Fabricate detention doors and frames rigid, neat in appearance, and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Weld exposed joints continuously; grind, fill, dress, and make smooth, flush, and invisible. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate detention doors and frames to comply with manufacturing tolerances indicated in NAAMM-HMMA 863.

C. Removable Jamb Faces: Provide removable jamb faces where required for access to embedded anchors. Fabricate to allow secure reattachment of removable face with security fasteners.

D. Fabricate multiple-opening detention frames with mullions that have closed tubular shapes and with no visible seams or joints.

E. Hardware Preparation: Factory prepare detention doors and frames to receive mortised hardware, including cutouts, reinforcement, mortising, drilling, and tapping, according to final Door Hardware Schedule and templates provided by detention door hardware supplier.

1. Reinforce detention doors and frames to receive surface-mounted door hardware. Drilling and tapping may be done at Project site.
2. Locate door hardware according to NAAMM-HMMA 863.

F. Factory cut openings in detention doors.

G. Weld components to comply with referenced AWS standard. Weld before finishing components to greatest extent possible. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish detention doors and frames after assembly.

2.9 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

2.10 SECURITY FASTENERS

A. Operable only by tools produced by fastener manufacturer or other licensed fabricator for use on specific fastener type. Provide drive-system type, head style, material, and protective coating as required for assembly, installation, and strength, and as follows:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Safety Socket LLC.
b. Tamperproof Screw Co., Inc.

c. Tamper-Pruf Screws.

2. Drive-System Type: Pinned Torx-Plus.
3. Fastener Strength: 120,000 psi (827 MPa).
4. Socket Button Head Fasteners:

   a. Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).
   b. Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.

5. Socket Flat Countersunk Head Fasteners:

   a. Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).
   b. Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.

6. Socket Head Cap Fasteners:

   a. Heat-treated alloy steel, ASTM A 574 (ASTM A 574M).
   b. Stainless steel, ASTM F 837 (ASTM F 837M), Group 1 CW.

7. Protective Coatings for Heat-Treated Alloy Steel:

   a. Zinc and clear trivalent chromium where indicated.
   b. Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide unless otherwise indicated.

2.11 SEALANTS

A. Epoxy Security Sealants: Manufacturer's standard, nonsag, tamper-resistant sealant for joints with no movement.

   1. Security sealants shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Products: Subject to compliance with requirements, provide one of the following:

      a. BASF Construction Chemicals, LLC, Building Systems; Epolith-G.
      b. Euclid Chemical Company (The), an RPM company; Euco Model No. 452-P.
      c. Pecora Corporation; DynaPoxy EP-1200.

2.12 ACCESSORIES

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of detention frame connections before detention frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Inspect embedded plate installations before installing detention frames to verify that plate installations comply with requirements. Prepare inspection reports.

1. Remove and replace plates where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.
2. Perform additional inspections to determine compliance of replaced or additional work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory.

B. Before installation and with shipping spreaders removed, adjust detention frames for squareness, alignment, twist, and plumbness to the following tolerances:

1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb and perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of face.
3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of door rabbet.
4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.

3.3 INSTALLATION

A. General: Install detention doors and frames plumb, rigid, properly aligned, and securely fastened in place, complying with Drawings, schedules, and manufacturer's written recommendations.

B. Anchorage: Set detention frame anchorage devices according to details on Shop Drawings and according to anchorage device manufacturer's written instructions.

1. Masonry Anchors: Coordinate frame installation to allow for solidly filling space between frames and masonry with grout.
2. Postinstalled Anchors: Drill holes in existing construction at locations to match bolt locations, and install bolt expansion shields or inserts.

C. Where detention frames are fabricated in sections due to shipping limitations, assemble frames and install angle splices at each corner, of same material and thickness as detention frame, and extend at least 4 inches (102 mm) on both sides of joint.

1. Field splice only at approved locations. Weld, grind, and finish as required to conceal evidence of splicing on exposed faces.
2. Continuously weld and finish smooth joints between faces of abutted, multiple-opening, detention frame members.
3. Field Welding: Comply with the following requirements:

a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
b. Obtain fusion without undercut or overlap.
c. Remove welding flux immediately.
d. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Apply bituminous coating to backs of frames before filling with grout.

E. Placing Detention Frames: Install detention frames of sizes and profiles indicated. Set detention frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
1. Install detention frames with removable stops located on secure side of opening.

F. Grout: Fully grout detention frame jambs and heads. Completely fill space between frames and adjacent substrates. Hand trowel grout and take other precautions, including bracing detention frames, to ensure that frames are not deformed or damaged by grout forces.

G. Security Sealant: Apply epoxy security sealant at all exposed gaps between detention frames and adjacent substrates.

H. Swinging Detention Doors: Fit non-fire-rated detention doors accurately in their frames, with the following clearances:

1. Between Doors and Frames at Jambs and Head: 1/8 inch (3.2 mm).
2. At Door Sills with Threshold: 3/8 inch (9.5 mm).
3. At Door Sills without Threshold: 3/4 inch (19 mm).
4. Between Door Bottom and Nominal Surface of Floor Covering: 1/2 inch (12.7 mm).

I. Installation Tolerances: Comply with installation tolerances indicated in NAAMM-HMMA 863.

J. Glazing: Comply with installation requirements in Section 088853 "Security Glazing" unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.

B. Detention work will be considered defective if it does not pass tests and inspections.

C. Perform additional inspections to determine compliance of replaced or additional work.

D. Prepare field quality-control certification that states installed products comply with requirements in the Contract Documents.

E. For verification that construction complies with requirements, select one detention door at random from detention doors delivered to Project and have it cut in half or otherwise taken apart.

1. Test Method: Verify weld strength by prying or chiseling door apart at edge seams, end channels, or stiffeners. Not more than 5 percent of welds may fail test.

a. If tested door fails, replace or rework all detention doors to bring them into compliance at Contractor's expense.
b. If tested door passes, replace tested door at Contractor's expense.

F. Prepare test and inspection reports.

3.5 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including detention doors and frames that are warped, bowed, or otherwise unacceptable.

B. Clean grout and other bonding material off detention doors and frames immediately after installation.

C. Stainless-Steel Surfaces: Clean surfaces according to manufacturer's written instructions.

END OF SECTION 083463

SECTION 083613 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:
   1. Electrically operated sectional doors with glass and aluminum infill panels.
   2. Glass and Glazing.
   3. Safety Stripe Applique.

B. Related Requirements:

   1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4, 16a-38k-4(b)5 and 16a-38k-4(d)9
      a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

   2. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type and size of sectional door and accessory.

   1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

C. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
   4. Include diagrams for power, signal, and control wiring.

D. Samples for Initial Selection: For units with factory-applied finishes.

1. Include Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Sectional Doors to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

B. Warranty: For Sectional Doors specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

B. Regulatory Requirements: Comply with applicable provisions in ICC A117.1.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Failure of components or operators before reaching required number of operation cycles.
c. Faulty operation of hardware.
d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
e. Delamination of exterior or interior facing materials.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain sectional doors from single source from single manufacturer.

1. Obtain operators and controls from sectional door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Sectional doors shall comply with performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.

B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Windstorm Pressure Resistance: 30 psf plus 1.5 safety factor yielding an ultimate windstorm pressure resistance of 45psf.
2. Lateral Pressures: 26.3 psf inward pressure, 28.5 psf outward pressure.
3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.

a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of the door width.
b. Deflection of horizontal track assembly shall not exceed 1/240 of the door height.

4. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.

C. Seismic Performance: Sectional doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Component Importance Factor: As indicated on Structural drawings.

2.3 DOOR ASSEMBLY

A. Aluminum Sectional Door: Sectional door formed with hinged sections and fabricated according to DASMA 102 unless otherwise indicated.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model 902I; Clopay Building Products.

B. Operation Cycles: Door components and operators capable of operating for not less than 100,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

C. Installed R-Value: 2.13 deg F x h x sq. ft./Btu (1.057 K x sq. m/W) or installed u-value of .469.

D. Stiles and Rails:

1. Face dimensions:
   a. Top and bottom rails: Nominal 3-1/2 inches (88.9mm) wide.
   b. Combined meeting rail pairs: Nominal 3-1/2 inches (88.9mm) wide.
   c. Center Stiles: Nominal 2-3/16 inches (55.56mm) wide.
   d. Intermediate Rails: 2-13/16 inches (71.44mm).
   e. End Stiles: Nominal 3-1/2 inches (88.9mm) wide.

2. Provide meeting rails designed for rabbetted weather joints.
3. Provide throughrods to secure stiles and rails and reinforcing fins on intermediate rails as required to meet performance requirements.

E. Track Configuration: High-lift,to be mounted tight to bottom of steel.

F. Weatherseals: Fitted to bottom and top and around entire perimeter of door. Provide combination bottom weatherseal and sensor edge.

G. Vision Panels: Glass panels with manufacturers standard glazing system.

1. Insulating Glass: Manufacturer's standard, ½ inch (13mm) total thickness.
   a. Clear Tempered Float Glass: 3 mm thick and complying with ASTM C 1036, Type 1, Class 1, Quality Q3.

H. Non-vision Panels: Manufacturers standard, ½ inch (13 mm) total thickness, comprised of insulated core with aluminum face and back sheets.

I. Roller-Tire Material: Case-hardened steel.

J. Locking Devices: Equip door with inside spring loaded slide bolt lock on end stile to encage slot in track.

K. Counterbalance Type: Torsion spring.

L. Electric Door Operator:

1. Usage Classification: Heavy duty, 25 or more cycles per hour and more than 90 cycles per day.
2. Operator Type: Jackshaft, center mounted.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.4 m) or lower.
4. Motor Exposure: Interior, clean, and dry.
5. Emergency Manual Operation: Chain type.
6. Obstruction-Detection Device: Automatic electric sensor edge on bottom section.

   a. Sensor Edge Bulb Color: Black.

7. Control Station: Interior-side mountedand exterior-side mounted, as indicated on Drawings.

M. Door Finish:

1. Aluminum Finish: Clear anodized.

2.4 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 ALUMINUM DOOR SECTIONS

A. Sections: Extruded-aluminum stile and rail members with dimensions and profiles as indicated on Drawings; members joined by welding or with concealed, 1/4-inch- (6-mm-) minimum diameter, aluminum or nonmagnetic stainless-steel through bolts, full height of door section; and with meeting rails shaped to provide a weather-resistant seal.

1. Aluminum: ASTM B 221 (ASTM B 221M) extrusions, alloy and temper standard with manufacturer for type of use and finish indicated; minimum thickness 0.065 inch (1.7 mm) for door section 2-1/8 inches (53.98 mm) deep, and as required to comply with requirements.
2. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Ensure that reinforcement does not obstruct vision lites.
3. Provide reinforcement for hardware attachment.

B. Insulated Metal Infill Panel: Manufacturers standard panel consisting of rigid polystyreneinsulation between two aluminum sheets, complying with ASTM B 209 (ASTM B 209M), alloy and temper standard with manufacturer for type of use and finish indicated, not less than 0.050 inch , set in continuous vinyl channel retained with rigid, snap-in, extruded-vinyl moldings or with rubber or neoprene glazing gasket with aluminum stop.

1. Total Thickness: 1 inch.

C. Full-Vision Panel Sections: Manufacturer's standard, tubular, aluminum-framed section fully glazed with 1/2 inch insulating tempered glass units set in vinyl, rubber, or neoprene glazing channel and with removable extruded-vinyl or aluminum stops.

2.6 TRACKS, SUPPORTS, AND ACCESSORIES

A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances indicated on Drawings, Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides for required door type, size, weight, and loading.

1. Galvanized Steel: ASTM A 653/A 653M, minimum G60 (Z180) zinc coating.
2. Slope tracks at an angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.

3. Track Reinforcement and Supports: Galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches (51 mm) apart for door-drop safety device.

   a. For Vertical Track: Continuous reinforcing angle attached to track and attached to wall with jamb brackets.
   b. For Horizontal Track: Continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.

B. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.

2.7 HARDWARE

A. General: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.

B. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch- (2.01-mm-) nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible. Provide double-end hinges where required, for doors more than 16 feet (4.88 m) wide unless otherwise recommended by door manufacturer.

C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch- (76-mm-) diameter roller tires for 3-inch- (76-mm-) wide track and 2-inch- (51-mm-) diameter roller tires for 2-inch- (51-mm-) wide track.

D. Push/Pull Handles: Equip each push-up operated or emergency-operated door with galvanized-steel lifting handles on each side of door, finished to match door.

2.8 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.

B. Chain Lock Keeper: Suitable for padlock.

C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.9 COUNTERBALANCE MECHANISM

A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A 229/A 229M, mounted on torsion

shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.

B. Weight Counterbalance: Counterbalance mechanism consisting of filled pipe weights that move vertically in a galvanized-steel weight pipe. Connect pipe weights with cable to weight-cable drums mounted on torsion shaft made of steel tube or solid steel.

C. Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to 16 feet (4.88 m) long and two additional brackets at one-third points to support shafts more than 16 feet (4.88 m) long unless closer spacing is recommended by door manufacturer.

D. Cables: Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 5 to 1.

E. Cable Safety Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.

F. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.

G. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.

2.10 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.

1. Jackshaft, Center Mounted: Jackshaft operator mounted on the inside front wall above door and connected to torsion shaft with an adjustable coupling or drive chain.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.

1. Electrical Characteristics:

a. Phase: Single phase.
b. Volts: 115 V.
c. Hertz: 60.

2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
3. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
5. Use adjustable motor-mounting bases for belt-driven operators.

E. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction Detection Device: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.

1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom section. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

a. Self-Monitoring Type: Four-wire configured device designed to interface with door-operator control circuit to detect damage to or disconnection of sensor edge.

G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure, push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
2. Exterior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

H. Emergency Manual Operation: Equip electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N).

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.11 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.13 ACCESSORIES

A. Safety/ Conspicuity Stripe Applique:

1. Apply polyester/ vinyl hazard identification tape to vision panels in patterns and locations shown on drawings.
2. Requirements:
   a. Colors: Alternating yellow and clear.
   b. Flexible prismatic reflective surface.
   c. Pre-sealed edges.
   d. Pressure sensitive adhesive application.
   e. 10 year warranty.
3. Installation: In accordance with manufacturer’s instructions and recommendations.
4. Products: Subject to compliance with requirements, products that may be incorporated into the work include, but not limited to, the following:

   a. Daybrite Reflective V92 by Reflexite Corporation.
   b. Premium Engineering Grade reflective tape by Nikkalite (Nippon Carbide Industries, USA, Inc.)
   c. Diamond Grade Series 983 conspicuity markings by 3M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Tracks:

1. Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches (610 mm) apart.
2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Power-Operated Doors: Install automatic garage doors openers according to UL 325.

3.3 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.

D. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780/A 780M.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083613

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior and interior storefront framing.
2. Storefront framing for window walls.
3. Storefront framing for punched openings.
4. Exterior and interior manual-swing entrance doors and door-frame units.
5. Horizontal Sliding windows.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4 and 16a-38k-4(d)9
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 087100 “Door Hardware” for door hardware.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:

    a. Joinery, including concealed welds.
    b. Anchorage.
    c. Expansion provisions.
    d. Glazing.
    e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

F. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

G. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer, licensed in the State of Connecticut, responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.

C. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Source quality-control reports.

E. Field quality-control reports.

F. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Aluminum-Framed Entrances and Storefronts to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

B. Warranty: For Aluminum-Framed Entrances and Storefronts specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

D. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 MOCKUPS

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration created by wind and thermal and structural movements.

c. Deterioration of metals and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.
e. Failure of operating components.

2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, licensed in the State of Connecticut, to design aluminum-framed entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Structural Drawings.

2. Other Design Loads:
a. Lateral Pressures:
1) Field: 26.3 psf inward pressure, 28.5 psf outward pressure.
2) Corner: 26.3 psf inward pressure, 35.1 psf outward pressure.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).

E. Structural: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
4. Lateral Pressures: 26.3 psf inward pressure, 28.5 psf outward pressure.

F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:

1. Fixed Framing and Glass Area:

   a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).

2. Entrance Doors:

   a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. (5.08 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
   b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. (2.54 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

G. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

H. Interstory Drift: Accommodate design displacement of adjacent stories indicated.

1. Design Displacement: As indicated on structural Drawings.
2. Test Performance: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement and 1.5 times the design displacement.

I. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.6 at design displacement and 1.5 times the design displacement.
2. Vertical Interstory Movement: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.7 at design displacement and 1.5 times the design displacement.

J. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K) as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.40 as determined according to NFRC 200.
3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 69 as determined according to NFRC 500.

K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).
c. Interior Ambient-Air Temperature: 75 deg F (24 deg C).

2.2 MANUFACTERERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide YWW 45 TU Thermal Window Wall System; YKK AP America Inc. or comparable product by one of the following:

1. Kawneer North America.
2. Oldcastle Building Envelope.

B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front.
4. Finish: High-performance organic finish.
5. Fabrication Method: Field-fabricated stick system.

B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

   a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
   b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
   c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
   d. Structural Profiles: ASTM B 308/B 308M.

2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

   a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
   b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
   c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch-(3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

   a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: As indicated.

3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

   a. Provide nonremovable glazing stops on outside of door.

2.5 HORIZONTAL SLIDING WINDOWS

A. Basis-of-Design Product: Subject to compliance with requirements, provide YSW400 T Horizontal Sliding Window; YKK AP America Inc..

B. Window Framing System:

1. AAMA Designation: HS-AW 40.
2. Description: Overall frame depth to be 4”. Fixed and sliding panels shall have overlapped joints, sealed, and dual screw spline joinery for extra strength and weatherability. Sliding panels shall not be removable when in a locked position. Windows including sliding as well as fixed panels, and frames shall be factory fabricated.
3. Thermal barrier shall consist of 6/6 nylon polyamide glass fiber reinforced pressure extruded bars. Systems employing non-structural thermal barriers are not acceptable.
4. Configuration: As indicated on drawings.
5. Glazing: Preformed EPDM glazing gasket.

C. Materials:

1. Extrusions: Aluminum Alloy 6063-T5 Temper (ASTM B 221).
2. Aluminum Sheet: ASTM B 209 (ASTM B 209M), 3003-H3 Aluminum Alloy, 0.080” (1.95) mm) minimum thickness.

2.6 HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."."

B. Horizontal Sliding Window Hardware: Standard adjustable acetal roller in stainless steel housing, cast aluminum cam-type sweep lock and stainless steel keeper.

2.7 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers**.**

C. Glazing Sealants: Comply with Section 088000 "Glazing."

2.8 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads**,** finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.9 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Storefront Framing: Fabricate components for assembly using screw-spline system.

F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.
2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

H. Horizontal Sliding Window:

1. Fabricate frame using two screws and adhesive backed gaskets at corner joints. Fixed and sliding panels shall have over lapped joints, sealed, and dual screw/spline joinery for extra strength and weatherability. Sliding panels shall not be removable when in a locked position.
2. Hardware: Drill and cut to template for hardware. Reinforce frames and door stiles to receive hardware in accordance with manufacturer's recommendations.
3. Fabrication Tolerances:
   a. Material Cuts: Square to 1/32 inch (0.8 mm) off square, maximum, over largest dimension; proportionate amount of 1/32 inch (0.8 mm) on other two dimensions.
   b. Joints (Between adjacent members in same assembly): Hairline and square to adjacent member.
   c. Variation (In squaring diagonals for doors and fabricated assemblies): 1/16 inch (1.6 mm).
   d. Flatness: +/- 1/16 inch (1.6 mm) off neutral plane.

I. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

J. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 ALUMINUM FINISHES

A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: [As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install glazing as specified in Section 088000 "Glazing."

F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.3 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
    c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).

B. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

    a. Perform a minimum of two tests in areas as directed by Architect.

C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 084113

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Glazed aluminum curtain walls.
2. Fire rated glazed aluminum curtain walls.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4 and 16a-38k-4(d)9
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 084113 “Aluminum-Framed Entrances and Storefronts” for manual swing entrance doors installed in Glazed Aluminum Curtain Walls.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.

2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:

   a. Joinery, including concealed welds.
   b. Anchorage.
   c. Expansion provisions.
   d. Glazing.
   e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

F. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

G. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer, licensed in the State of Connecticut, responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

B. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.

C. Product Test Reports: For glazed aluminum curtain walls, for tests performed by manufacturer and witnessed by a qualified testing agency .

D. Source quality-control reports.

E. Field quality-control reports.

F. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Glazed Aluminum Curtain Walls to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

B. Warranty: For Glazed Aluminum Curtain Walls specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 MOCKUPS

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 WARRANTY - GLAZED ALUMINUM CURTAIN WALLS AND FIRE RATED GLAZED ALUMINUM CURTAIN WALLS

A. Special Assembly Warranty: Manufacturer agrees to repair or replace components of glazed aluminum curtain walls that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.

b. Noise or vibration created by wind and thermal and structural movements.
c. Deterioration of metals and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.
e. Failure of operating components.

2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, licensed in the State of Connecticut," to design glazed aluminum curtain walls.

B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Structural Drawings.
2. Other Design Loads:
a. Lateral Pressures:
1) Field: 26.3 psf inward pressure, 28.5 psf outward pressure.
2) Corner: 26.3 psf inward pressure, 35.1 psf outward pressure.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).

    a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.

E. Structural: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

4. Lateral Pressures: 26.3 psf inward pressure, 28.5 psf outward pressure.

F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:

1. Fixed Framing and Glass Area:

    a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).

G. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

H. Interstory Drift: Accommodate design displacement of adjacent stories indicated.

1. Design Displacement: As indicated on Drawings.
2. Test Performance: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement and 1.5 times the design displacement.

I. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.6 at design displacement and 1.5 times the design displacement.
2. Vertical Interstory Movement: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.7 at design displacement and 1.5 times the design displacement.

J. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K) as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.40 as determined according to NFRC 200.
3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 61 as determined according to NFRC 500.

K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

   a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
   b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).

L. Performance Requirements for Fire Rated Glazed Aluminum Curtain Walls:

1. Fire Resistive Wall Assembly Certifications: 60-120 minute fire resistive wall assemblies tested in accordance with ASTM E119, NFPA 251 and UL 263.
2. Fire Resistive Door Assembly Certifications: 60-90 minute fire resistive door assemblies tested in accordance with ASTM E119, NFPA 251 and UL.
3. Fire Protective Door Assembly Certifications: 20-45 minute fire protective door assemblies shall be tested in accordance with NFPA 80, NFPA 252, ASTM E152, ASTM E2074, UL 10B and UL.

2.2 MANUFACTURERS

A. Glazed Aluminum Curtain Wall Basis-of-Design Product: Subject to compliance with requirements, provide YCW 750 OG; YKK-AP America, Inc.

B. Fire Rated Glazed Aluminum Curtain Wall Basis-of-Design Product: Subject to compliance with requirements, provide SAFTIfire; SaftiFirst Fire Rated Glazing Solutions.

C. Source Limitations: Obtain all components of curtain wall system, including framing spandrel panels, venting windows, entrances, sun control and accessories, from single manufacturer.

2.3 FRAMING - GLAZED ALUMINUM CURTAIN WALLS

A. Framing Members: Manufacturer's extruded- -aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front.
4. Finish: High-performance organic finish.
5. Fabrication Method: Either factory- or field-fabricated system.

B. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
d. Structural Profiles: ASTM B 308/B 308M.

2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.4 FRAMING - FIRE RATED GLAZED ALUMINUM CURTAIN WALLS

A. Internal Members: Internal tube steel framing shall conform to ASTM A501. Formed steel retainers shall be galvanized conforming to ASTM A527.

B. Insulation: Manufacturers standard fire staffing insulation to insulate internal members against the effects of fire, smoke and heat transfer from either side.

C. Fasteners: Type recommended by manufacturer.

D. Framing covers: Manufacturer's extruded 6063-T5 aluminum alloy covers of thickness required.

1. Finish: High-Performance Organic Finish.

E. Glazing accessories: Glazing material perimeter shall be separated from the perimeter framing system with manufacturers approved glazing tape for designated fire rating.

2.5 VENTING WINDOWS

A. Basis-of-Design Product: Subject to compliance with requirements, provide YES SSG TU Vent; YKK-AP America, Inc.

B. Aluminum Windows: AAMA/WDMA/CSA 101/I.S.2/A440, manufacturer's standard, with self-flashing mounting fins, and as follows:

1. Window Type: Awning.
2. Minimum Performance Class: AW.
3. Minimum Performance Grade: 65 .
4. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 0.064-inch (1.63-mm) thickness at any location for main frame and sash members.

   a. Thermally Broken Construction: Fabricate window units with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.

5. Mullions: Between adjacent windows, fabricated of extruded aluminum matching finish of window units.
6. Fasteners, Anchors, and Clips: Nonmagnetic stainless steel, aluminum, or other noncorrosive material, compatible with aluminum window members, trim, hardware, anchors, and other components of window units. Fasteners shall not be exposed, except for attaching hardware.

   a. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.128 inch (3.26 mm) thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, spline grommet nuts.

7. Hardware: Manufacturer's standard; of aluminum, stainless steel, die-cast steel, malleable iron, or bronze; including the following:

   a. Dual Roto-Operator.
   b. .
   c. Steel or bronze operating arms.
8. Insect Screens: Provide removable insect screen on each operable exterior sash, with screen frame finished to match window unit, complying with SMA 1004 or SMA 1201, and as follows:

a. Aluminum Wire Fabric: 18-by-18 (1.1-by-1.1-mm), 18-by-16 (1.1-by-1.3-mm), or 18-by-14 (1.1-by-1.5-mm) mesh of 0.013-inch- (0.3-mm-) diameter, coated aluminum wire.

C. Glazing: Same as adjacent glazed aluminum curtain-wall glazing.

D. Finish: Match adjacent glazed aluminum curtain-wall finish.

2.6 ENTRANCES

A. Entrances: Comply with Section 084113 "Aluminum-Framed Entrances and Storefronts."

2.7 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

2.8 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads**,** finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.9 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Fabricate components to resist water penetration as follows:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Curtain-Wall Framing: Fabricate components for assembly using shear-block system.

F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 ALUMINUM FINISHES

A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Section 088000 "Glazing."

G. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

H. Install mineral wool fire stop insulation or appropriately rated intumescent sealant at perimeter of the framing system to the rough opening at fire rated glazing curtainwall systems.

3.3 ERECTION TOLERANCES

A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:

a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).

4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Test Area: Perform tests on one bay at least 30 feet (9.1 m), by one story.

C. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
   a. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.

2. Air Infiltration: ASTM E 783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
   a. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.

3. Water Penetration: ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.

D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 084413

SECTION 085653 - SECURITY WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fixed, transaction security windows.
2. Decorative film overlay for security windows.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4 and 16a-38k-4(b)5
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 088853 "Security Glazing" for glazing to be installed in security windows.

1.3 COORDINATION

A. Coordinate installation of anchorages for security windows. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in adjacent construction. Deliver such items to Project site in time for installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for window units.

C. Shop Drawings: For security windows.

1. Include plans, elevations, sections, and attachments to other work.
2. Full-size section details of framing members, including internal armoring, reinforcement, and stiffeners.
3. Location of weep holes.
4. Glazing details.
5. Details of deal tray package receiver and speaking aperture

D. Samples for Initial Selection: For frame members with factory-applied color finishes.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Welding certificates.

C. Product Test Reports: For each type of security window and accessory indicated as ballistics resistant, for tests performed by a qualified testing agency.

D. Configuration Disclosure Drawing: For each type of forced-entry-resistant security window, complying with ASTM F 1233.

E. Sample Warranty: For special warranty.

F. Examination reports documenting inspections of substrates, areas, and conditions.

G. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

H. Field quality-control reports documenting inspections of installed products.

1. Field quality-control certification signed by Contractor.

1.7 CLOSEOUT SUBMITTALS

A. Warranty: For Security Windows specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation of units required for this Project.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Pack security windows in wood crates for shipment. Crate glazing separate from frames unless factory glazed.

B. Label security window packaging with drawing designation.

C. Store crated security windows on raised blocks to prevent moisture damage.

1.10 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.11 SEQUENCING

A. Field Painting: Except where security windows have been preglazed before installation, complete field painting of security windows before glazing installation.

1.12 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace security windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including deflections exceeding 1/4 inch (6 mm).
b. Failure of welds.
c. Faulty operation of package receiver.
d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Attack Resistance: Provide units identical to those tested for compliance with requirements indicated, and as follows:

1. Ballistics Resistance: Listed and labeled as Level 3 when tested according to UL 752.

2.2 FIXED, TRANSACTION SECURITY WINDOWS

A. Provide fixed, framed transaction windows with transparent package receiver, recessed deal tray and speaking aperture, capable of allowing transfer of currency and documents.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model SSTW-07;Armortex (View Window VW-3) and SSFW-50 (View Window VW-10a).

B. Configuration: One fixed-glazed panel.

C. Framing: Fabricate perimeter channel framing, mullions, and glazing stops from stainless steel as follows:

1. Profile: Manufacturer's standard, with minimum face dimension indicated.

a. Minimum Face Dimension: 1 1/2 inches.

2. Depth: 4 1/2 inches..

D. Head and Jamb Framing: Designed for glazing tape at VW-10a and voice communication by speech at normal volume at VW-3.

E. Channel-Frame Sill: Formed from stainless steel and designed for sealant glazing.

1. Transaction Counter: Stainless steel, 12 inches (305 mm) deep by width of security window, with integral deal tray centered in opening.

F. Glazing and Glazing Materials: Comply with requirements in Section 088853 "Security Glazing."

G. Materials:

1. Mild Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666 or ASTM A 240/A 240M, austenitic stainless steel, Type 304.

2.3 FABRICATION

A. General: Fabricate security windows to provide a complete system for assembly of components and anchorage of window units.

1. Provide units that are re-glazable from the secure side without dismantling the non-secure side of framing.
2. Prepare security windows for glazing unless pre-glazing at the factory is indicated.

B. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.

1. Fabricate framing with manufacturer's standard, internal opaque armoring in thicknesses required for security windows to comply with ballistics-resistance performance indicated.

C. Glazing Stops: Finish glazing stops to match security window framing.

1. Secure-Side Glazing Stops: Welded or integral to framing.
2. Non-secure-Side Glazing Stops: Removable, coordinated with glazing indicated.

D. Welding: Weld components to comply with referenced AWS standard. To greatest extent possible, weld before finishing and in concealed locations to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

E. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

F. Factory-cut openings in glazing for speaking apertures.

G. Pre-glazed Fabrication: Pre-glaze window units at factory, where required for applications indicated. Comply with requirements in Section 088853 "Security Glazing."

H. Weather Stripping: Factory applied.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

2.6 ACCESSORIES

A. Recessed Deal Trays: Formed from stainless steel; fabricated in curved shape with exposed flanges for recessed installation into horizontal surface.

1. Clear Opening Size: 12 inches wide by 8 inches deep by 1-1/2 inches high (305 mm wide by 203 mm deep by 38 mm high).

B. Transparent Package Receiver : Formed from bullet resistant polycarbonate..

1. Clear Opening Size: Roughly 14 inches x 14 inches x 14 inches. Ballistics Resistance: UL Level 3.
2. Listed and labeled as bullet resisting according to UL 752.

C. Speaking Apertures: Fabricate from stainless steel, designed to allow passage of speech at normal speaking volume without distortion.

1. Shape: Circular.
2. Ballistics Resistance: UL Level 3.
3. Listed and labeled as bullet resisting according to UL 752.

D. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.

E. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

F. Miscellaneous Glazing Materials: Provide material, size, and shape complying with requirements of glass manufacturers and with a proven record of compatibility with surfaces contacted in installation.

1. Cleaners, Primers, and Sealers: Type recommended by sealant or gasket manufacturer.
2. Setting Blocks: Elastomeric material with a Type A Shore durometer hardness of 85, plus or minus 5.
3. Spacers: Elastomeric blocks or continuous extrusions with a Type A Shore durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
4. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

G. Anchors, Clips, and Window Accessories: Stainless steel; hot-dip, zinc-coated steel or iron, complying with ASTM B 633; provide sufficient strength to withstand design pressures indicated.

H. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

I. Sealants: For sealants required within fabricated security windows, provide type recommended by manufacturer for joint size and movement. Sealant shall remain permanently elastic, non-shrinking, and non-migrating.

J. Decorative Film Overlay: Use translucent, dimensionally stable, cast PVC film, 2-mil- (0.05-mm-) minimum thickness, with pressure-sensitive, clear adhesive back for adhering to glass and releasable protective backing.

1. Products: Subject to compliance with requirements, provide products by one the following:

a. 3M.
b. Avery Dennison Graphics.
c. FDC Graphic Films, Inc.

2. Use: Suitable for exterior and interior applications.
3. Color: As selected by Architect from manufacturer's full range

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of security windows.

B. Examine roughing-in to verify actual locations of security window connections before security window installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of security windows.

D. For glazing materials whose orientation is critical for performance, verify installation orientation.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing security windows to in-place construction. Include threaded fasteners for inserts, security fasteners, and other connectors.

B. Glazed Framing: Provide gasket-glazed framing. Comply with installation requirements in Section 088853 "Security Glazing."

C. Removable Glazing Stops and Trim: Fasten components with security fasteners.

D. Fasteners: Install security windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials.

E. Sealants: Comply with requirements in Section 079200 "Joint Sealants" for installing sealants, fillers, and gaskets.

F. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended in writing by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

G. Decorative Film Overlay: Apply squarely aligned to glass edges, uniformly smooth, and free from tears, air bubbles, wrinkles, and rough edges, in single sheet completely overlaying the back face of clean glass, according to manufacturer's written instructions, including surface preparation and application temperature limitations.

3.3 FIELD QUALITY CONTROL

A. Inspect installed products to verify compliance with requirements. Prepare inspection reports and indicate compliance with and deviations from the Contract Documents.

B. Perform additional inspections to determine compliance of replaced or additional work. Prepare inspection reports.

C. Prepare field quality-control certification that states installed products and their installation comply with requirements in the Contract Documents.

3.4 ADJUSTING

A. Adjust package receiver to provide a tight fit at contact points for smooth operation and secure enclosure.

B. Remove and replace defective work, including security windows that are warped, bowed, or otherwise unacceptable.

3.5 CLEANING AND PROTECTION

A. Clean surfaces promptly after installation of security windows. Take care to avoid damaging the finish. Remove excess glazing and sealant compounds, dirt, and other substances.

B. Clean glass of pre-glazed security windows promptly after installation. Comply with requirements in Section 088853 "Security Glazing" for cleaning and maintenance.

C. Provide temporary protection to ensure that security windows are without damage at time of Substantial Completion.

END OF SECTION 085653

SECTION 086200 - UNIT SKYLIGHTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Unit skylights mounted on site-erected curbs.

B. Related Requirements:

   1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4 and 16a-38k-4(b)5
      a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of unit skylight.

   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for unit skylights.

C. Shop Drawings: For unit skylight work.

   1. Include plans, elevations, sections, details, and connections to supporting structure and other adjoining work.

D. Aluminum Finish Samples: For each type of exposed finish required, in a representative section of each unit skylight in manufacturer's standard size.

E. Glazing Samples: For each color and finish of glazing indicated, 12 inches (300 mm) square and of same thickness indicated for the final Work.

F. Product Schedule: For unit skylights.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type and size of unit skylight, for tests performed within the last four years by a qualified testing agency. Test results based on testing of smaller unit skylights than specified will not be accepted.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Unit Skylights to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

B. Warranty: For Unit Skylights specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating unit skylights that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.

B. Installer Qualifications: An installer acceptable to unit skylight manufacturer for installation of units required for this Project.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of unit skylights that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Uncontrolled water leakage.
   b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   c. Deterioration of insulating-glass hermetic seal.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Model FCM; fixed curb mount; Velux, America, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Unit Skylight Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
   1. Performance Class and Grade: Min. Class CW-PG 50.
   2. Certification: AAMA-, WDMA-, or CSA-certified unit skylights with label attached to each.

B. Thermal Transmittance: NFRC 100 maximum U-factor of 0.50 Btu/sq. ft. x h x deg F (2.83 W/sq. m x K) max..

C. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum SHGC of 0.26 max..

D. General: Provide factory-assembled unit skylights that include glazing, extruded-aluminum glazing retainers, gaskets, and inner frames and that are capable of withstanding performance requirements indicated.

E. Unit Shape and Size: Rectangular, 22 1/2-by-46 1/2-inch inside curb.

F. Insulating Glass: Clear, sealed units that comply with Section 088000 "Glazing," in manufacturer's standard overall thickness.

   1. Exterior Lite: 6-mm fully tempered glass.
   2. Interior Lite: Laminated glass; two plies of 3-mm clear heat-strengthened glass with 0.030-inch (0.762-mm) clear polyvinyl butyral interlayer.
   3. Interspace Content: Argon.
   4. Low-Emissivity Coating: Manufacturer's standard.

G. Glazing Gaskets: Manufacturer's standard.

H. Condensation Control: Fabricate unit skylights with integral internal gutters and nonclogging weeps to collect and drain condensation to the exterior.

I. Thermal Break: Fabricate unit skylights with thermal barrier separating exterior and interior metal framing.

2.3 ACCESSORY MATERIALS

A. Fasteners: Same metal as metal being fastened, nonmagnetic stainless steel, or other noncorrosive metal as recommended by manufacturer. Finish exposed fasteners to match material being fastened.

1. Where removal of exterior exposed fasteners might allow access to building, provide nonremovable fastener heads.

B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat.

2.4 ALUMINUM FINISHES

A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate installation of unit skylight with installation of substrates, vapor retarders, roof insulation, roofing membrane, and flashing as required to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight.

B. Comply with recommendations in AAMA 1607 and with manufacturer's written instructions for installing unit skylights.

C. Install unit skylights level, plumb, and true to line, without distortion.

D. Anchor unit skylights securely to supporting substrates.

E. Where aluminum surfaces of unit skylights will contact another metal or corrosive substrates, such as preservative-treated wood, apply bituminous coating on concealed metal surfaces or provide other approved permanent separation recommended in writing by unit skylight manufacturer.

3.3 FIELD QUALITY CONTROL

A. After completion of installation and nominal curing of sealant and glazing compounds but before installation of interior finishes, test for water leaks according to AAMA 501.2.

B. Perform test for total area of each unit skylight.

C. Work will be considered defective if it does not pass tests and inspections.

D. Additional testing and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Prepare test and inspection reports.

3.4 CLEANING

A. Clean exposed unit skylight surfaces according to manufacturer's written instructions. Touch up damaged metal coatings and finishes.

B. Remove excess sealants, glazing materials, dirt, and other substances.

C. Remove and replace glazing that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect unit skylight surfaces from contact with contaminating substances resulting from construction operations.

END OF SECTION 086200

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Cylinders specified for doors in other sections.

C. Related Sections:

1. Section 081113 "Hollow Metal Doors and Frames" for astragals provided as part of labeled fire-rated assemblies and for door silencers provided as part of hollow-metal frames.
2. Section 081119 "Stainless-Steel Doors and Frames" for astragals provided as part of labeled fire-rated assemblies and for door silencers provided as part of stainless steel frames.
3. Section 081216 "Aluminum Frames" for door silencers provided as part of aluminum frames.
4. Section 081416 "Flush Wood Doors" for integral intumescent seals provided as part of labeled fire-rated assemblies.
5. Section 083113 "Access Doors and Frames" for access door hardware, including cylinders.
6. Section 083323 "Overhead Coiling Doors" for door hardware provided as part of overhead door assemblies.
7. Section 083463 "Detention Doors and Frames" for door silencers provided as part of detention frames.
8. Section 281300 "Access Control" for access control devices installed at door openings and provided as part of a security system.
9. Section 283100 " Addressable Fire-Alarm Detection System" for connections to building fire-alarm system.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 80 - Fire Doors and Windows.
4. NFPA 101 - Life Safety Code.
5. NFPA 105 - Installation of Smoke Door Assemblies.
6. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

C. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data,

Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

D. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

   a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
   b. Complete (risers, point-to-point) access control system block wiring diagrams.

2. Electrical Coordination: Coordinate with related Division 26 Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.

E. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

G. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.4 QUALITY ASSURANCE SUBMITTALS

A. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Door Hardware to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

B. Warranty: For Door Hardware specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 3 years documented experience installing both standard and electrified builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor in good standing by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

   1. Scheduling Responsibility: Preparation of door hardware and keying schedules.

D. Source Limitations: Obtain each type and variety of Door Hardware specified in this Section from a single source, qualified supplier unless otherwise indicated.

   1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

   2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

E. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:

   1. NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

   2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:

      a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
      b. Door Closers: Comply with the following maximum opening-force requirements indicated:

         1) Interior Hinged Doors: 5 lbf applied perpendicular to door.

2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.

3. NFPA 101: Comply with the following for means of egress doors:

a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.

b. Thresholds: Not more than 1/2 inch high.

4. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.

a. Test Pressure: Positive pressure labeling.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.8 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.9 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:
1. Seven years for heavy duty cylindrical (bored) locks and latches.
2. Twenty five years for manual surface door closers.

1.10 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

1. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

a. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

B. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity, unless otherwise indicated:

    a. Two Hinges: For doors with heights up to 60 inches.
    b. Three Hinges: For doors with heights 61 to 90 inches.
    c. Four Hinges: For doors with heights 91 to 120 inches.
    d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

    a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
    b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

    a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
    b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:

    a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:

        1) Out-swinging exterior doors.
        2) Out-swinging access controlled doors.
        3) Out-swinging lockable doors.

5. Manufacturers: Subject to requirements, provide products by one of the following:

    a. Bommer Industries (BO).
    b. McKinney Products (MK).
    c. Stanley Hardware (ST).

B. Continuous Geared Hinges: ANSI/BHMA A156.26 certified continuous geared hinge with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Provide concealed flush mount (with or without inset), full surface, or half surface, in standard and heavy duty models, as specified in the Hardware Sets. Concealed continuous hinges to be U.L. listed for use on up to and including 90 minute rated door installations and U.L. listed for windstorm components where applicable. Factory cut hinges for door size and provide with removable service power transfer panel where indicated at electrified openings.

1. Manufacturers: Subject to requirements, provide products by one of the following:

    a. Bommer Industries (BO).
    b. McKinney Products (MK).

c. Pemko Manufacturing (PE).

C. Pin and Barrel Continuous Hinges: ANSI/BHMA A156.26 certified pin and barrel continuous hinges with minimum 12 gauge (.105) Type 304 stainless steel hinge leaves, concealed teflon-coated stainless pin, and twin self-lubricated nylon bearings at each knuckle separation. Fabricate hinges non-handed and U.L. listed for use on up to and including 3 hour rated doors and U.L. listed for windstorm components where applicable. Provide hinges with power transfer cutouts where indicated at electrified openings.

1. Manufacturers: Subject to requirements, provide products by one of the following:

a. Markar Products (MR).
b. McKinney Products (MK).
c. Pemko Manufacturing (PE).

2.3 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified automatic, self-latching, and manual flush bolts and surface bolts. Manual flush bolts to be furnished with top rod of sufficient length to allow bolt location approximately six feet from the floor. Furnish dust proof strikes for bottom bolts. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

1. Manufacturers: Subject to requirements, provide products by one of the following:

a. Burns Manufacturing (BU).
b. Rockwood Manufacturing (RO).
c. Trimco (TC).

2.4 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. Cylinders: Original manufacturer cylinders complying with the following:

1. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
5. Keyway: Match Facility Standard.

D. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:

1. Interchangeable Cores: Core insert, removable by use of a special key; usable with other manufacturers' cylinders.

E. Keying System: Each type of lock and cylinders to be factory keyed. Conduct specified "Keying Conference" to define and document keying system instructions and requirements. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner. Incorporate decisions made in keying conference, and as follows:

1. Master Key System: Cylinders are operated by a change key and a master key.
2. Grand Master Key System: Cylinders are operated by a change key, a master key, and a grand master key.
3. Great-Grand Master Key System: Cylinders are operated by a change key, a master key, a grand master key, and a great-grand master key.
4. Existing System: Master key or grand master key locks to Owner's existing system.
5. Keyed Alike: Key all cylinders to same change key.

F. Key Quantity: Provide the following minimum number of keys:

1. Top Master Key: One (1)
2. Change Keys per Cylinder: Two (2)
3. Master Keys (per Master Key Group): Two (2)
4. Grand Master Keys (per Grand Master Key Group): Two (2)
5. Construction Keys (where required): Ten (10)
6. Construction Control Keys (where required): Two (2)
7. Permanent Control Keys (where required): Two (2)

G. Construction Keying: Provide construction master keyed cylinders or temporary keyed construction cores where specified. Provide construction master keys in quantity as required by project Contractor. Replace construction cores with permanent cores. Furnish permanent cores for installation as directed under specified "Keying Conference".

H. Key Registration List: Provide keying transcript list to Owner's representative in the proper format for importing into key control software.

I. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Manufacturers: Subject to requirements, provide products by one of the following:

a. Lund Equipment (LU).
b. MMF Industries (MM).
c. Telkee (TK).

2.5 MECHANICAL LOCKS AND LATCHING DEVICES

A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Grade 1 certified cylindrical (bored) locksets furnished in the functions as specified in the Hardware Sets. Lock chassis fabricated of heavy gauge steel, zinc dichromate plated, with through-bolted application. Furnish with solid cast levers, standard 2 3/4” backset, and 1/2" (3/4" at rated paired openings) throw brass or stainless steel latchbolt. Locks are to be non-handed and fully field reversible.

1. Manufacturers: Subject to requirements, provide products by one of the following:

   a. Corbin Russwin Hardware (RU) – CL3300 Series.
   b. Sargent Manufacturing (SA) – 10 Line.
   c. Stanley Best (BE) – 9K Series.

B. Lock Trim Design: As specified in Hardware Sets.

2.6 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
4. Dustproof Strikes: BHMA A156.16.

2.7 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the

proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.

a. Fire Exit Removable Mullions: Provide keyed removable mullions for use with fire exit devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252. Mullions to be used only with exit devices for which they have been tested.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Flush End Caps: Provide heavy weight impact resistant flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.

5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty trim with cold forged escutcheons, beveled edges, and four threaded studs for thru-bolts.

a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets. Provided free-wheeling type trim where indicated.
b. Where function of exit device requires a cylinder, provide an interchangeable core type keyed cylinder (Rim or Mortise) as specified in Hardware Sets.

6. Vertical Rod Exit Devices: Provide and install interior surface and concealed vertical rod exit devices as Less Bottom Rod (LBR) unless otherwise indicated.

7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.

8. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

9. Rail Sizing: Provide exit device rails factory sized for proper door width application.

10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Mounting rails to be formed from smooth stainless steel, brass or bronze architectural materials no less than 0.072" thick, with push rails a minimum of 0.062" thickness. Painted or aluminum metal rails are not acceptable. Exit device latch to be investment cast stainless steel, pullman type, with deadlock feature.

1. Manufacturers: Subject to requirements, provide products by one of the following:

a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
b. Sargent Manufacturing (SA) - 80 Series.
c. Von Duprin (VD) - 35A/98 XP Series.

2.8 ELECTROMECHANICAL CONVENTIONAL EXIT DEVICES

A. Electrified Conventional Push Rail Devices (Heavy Duty): Subject to same compliance standards and requirements as mechanical exit devices, electrified devices to be of type and design as specified below.

1. Manufacturers: Subject to requirements, provide products by one of the following:

   a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
   b. Sargent Manufacturing (SA) - 80 Series.
   c. Von Duprin (VD) - 35A/98/99 Series.

B. Electrified Options: As indicated in hardware sets, provide electrified exit device options including: electric latch retraction , electric dogging, outside door trim control, exit alarm, delayed egress, latchbolt monitoring, lock/unlock status monitoring, touchbar monitoring and request-to-exit signaling. Unless otherwise indicated, provide electrified exit devices standard as fail secure.

2.9 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.

2. Standards: Closers to comply with UL-10C and UBC 7-2 for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Cycle Testing: Provide closers which have surpassed 10 million cycles in a test witnessed and verified by UL.

4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.

5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

   a. Where closers are indicated to have mechanical dead-stop, provide heavy duty arms and brackets with an integral positive stop.
   b. Where closers are indicated to have mechanical hold open, provide heavy duty units with an additional built-in mechanical holder assembly designed to hold open against normal wind and traffic conditions. Holder to be manually selectable to on-off position.
   c. Where closers are indicated to have a cushion-type stop, provide heavy duty arms and brackets with spring stop mechanism to cushion door when opened to maximum degree.

d. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics. Provide drop plates or other accessories as required for proper mounting.

6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door Hardware Sets.

B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

1. Manufacturers: Subject to requirements, provide products by one of the following:

a. Corbin Russwin Hardware (RU) - DC8000 Series.
b. LCN Closers (LC) - 4040XP Series.
c. Sargent Manufacturing (SA) - 281 Series.

C. Door Closers, Surface Mounted (Cam Action): ANSI/BHMA 156.4, Grade 1 certified surface mounted, high efficiency door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be of the cam and roller design, one piece cast aluminum silicon alloy body with adjustable backcheck and independently controlled valves for closing sweep and latch speed.

1. Manufacturers: Subject to requirements, provide products by one of the following:

a. Corbin Russwin (RU) - DC5000 Series.
b. Norton Door Controls (NO) - 2800ST Series.
c. Sargent Manufacturing (SA) - 421 Series.

2.10 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Metal Protection Plates: ANSI/BHMA A156.6 certified metal protection plates (kick, armor, or mop), beveled on four edges (B4E), fabricated from the following.

a. Stainless Steel: 050-inch thick, with countersunk screw holes (CSK).
b. Brass or Bronze: 050-inch thick, with countersunk screw holes (CSK).

c. Laminate Plastic or Acrylic: 1/8-inch thick, with countersunk screw holes (CSK).

4. Fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets.

5. Metal Door Edging: Door protection edging fabricated from a minimum .050-inch thick metal sheet, formed into an angle or "U" cap shapes, surface or mortised mounted onto edge of door. Provide appropriate leg overlap to account for protection plates as required. Height to be as specified in the Hardware Sets.

6. Manufacturers: Subject to requirements, provide products by one of the following:

a. Burns Manufacturing (BU).
b. Rockwood Manufacturing (RO).
c. Trimco (TC).

2.11 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers: Subject to requirements, provide products by one of the following:

a. Burns Manufacturing (BU).
b. Rockwood Manufacturing (RO).
c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers: Subject to requirements, provide products by one of the following:

a. Rixson Door Controls (RF).
b. Rockwood Manufacturing (RO).
c. Sargent Manufacturing (SA).

2.12 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and

provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers: Subject to requirements, provide products by one of the following:

1. Pemko Manufacturing (PE).
2. Reese Enterprises, Inc. (RS).
3. Zero International (ZE).

2.13 ELECTRONIC ACCESSORIES

A. Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

1. Basis-of-Design Product: Subject to requirements, provide:

a. Securitron (SU) - BPS Series.

2.14 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.15 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

B. Six Month Adjustment: Approximately six months after the issuance of the Certificate of Compliance, the Installer, accompanied by representatives of latchsets and locksets and of door control devices, and of other major hardware suppliers, shall return to the Project to perform the following work:

1. Examine and readjust each item of door hardware as necessary to restore function of doors and hardware to comply with specified requirements.
2. Consult with and instruct Engineer in recommended additions to the maintenance procedures.
3. Replace hardware items that have deteriorated or failed due to faulty design, materials, or installation of hardware units.
4. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. and provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SCHEDULE

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. Refer to Section 080671, Door Hardware Schedule, for hardware sets.

END OF SECTION 087100

SECTION 087650 - ASSISTIVE WINDOW ACTUATOR

PART 1 -GENERAL

1.1 DESCRIPTION:

A. Description of Work: Work of this Section includes, but is not limited to, the following:

1. Electric dual chain window actuators.

B. Related Work Specified Elsewhere:

1. Aluminum Windows: Section 084413 Glazed Aluminum Curtain Walls.
2. See Division 26 sections for electrical requirements.
3. Division 01, High Performance Buildings Requirements Section for credit 16a-38k-4(b)4.
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 REFERENCES

A. ANSI A117.1-1998 sections 506 and 1002.13; ANSI A117.1-1992 sect's 4.12 and 4.25.

B. Life Safety Code NFPA 10, Emergency Escape and Rescue Openings.

C. Building Codes-Current state building code and IBC: all applicable sections.

D. ADAAG, Section 4.27 Controls and Operating Mechanisms.

E. UFAS Section 4.34.2(9) and 4.27 and Retrofit Manual, Section 4.12, pg. 98-101.

F. AAMA/ANSI 101-93, Voluntary Specifications for Windows and Sliding Doors.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Submit manufacturer's specifications and installation instructions for materials.

C. Shop Drawings:
   1. Show existing field conditions of installed windows and defining the following:
      a. Jamb depth.
      b. Window/jamb/head/mullion(s) dimensions and configurations.
      c. Verification of movable sash attachment area.

d. Distance between jambs.
e. Distance between head and finished sill.
f. Distance from finished floor to finished sill.

2. Approved floor plan indicating window location(s) within project by discrete number or letter. Indicate preferred control location -right or left handed, and height of sill above finished floor.
3. Scaled or dimensioned window construction drawings (including sections) from window manufacturer.
4. Indicate non-standard layout and placement of actuator.

D. Warranty: Submit signed and dated warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Assistive Window Actuator to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS .

B. Warranty: For Assistive Window Actuator specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 PERFORMANCE REQUIREMENTS

A. Window actuating system to be compatible with type and model of window to be modified.

B. Window actuating system to open, close and latch windows within referenced standards and codes in paragraph 1.2.

1.6 SYSTEM REQUIREMENTS

A. Interface With Other Systems:
1. Coordinate window actuator Work with Work of other trades.
2. Provide materials and accessories in timely manner so as not to delay Work.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Obtain window actuator system from manufacturer with not less than 5 years documented, successful experience in supplying specified Work.

B. Installer Qualifications:
1. Not less than 3 years documented successful experience with work comparable to Work of this Project.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, handle and protect products in accordance with manufacturer's instructions.

B. Deliver materials in manufacturer's unopened containers, fully identified with brand, type, grade, class and all other qualifying information.

C. Take necessary precautions to keep products clean, dry and free of damage.

1.9 PROJECT CONDITIONS

A. Ensure compatibility of actuator with venting window provided by Section 084413 Glazed Aluminum Curtain Walls.

B. Window shall be mounted with consideration for actuator control location (refer to ANSI A117.1 for reach requirements). Adjoining walls, cabinets, furniture, and other reach obstructions must be considered.

C. Coordinate with submittals for Section 084413 Glazed Aluminum Curtain Walls to ensure compatibility of actuator with intended vented window units.

1.10 SEQUENCING

A. Sequence installation of window actuator after completion of finishes surrounding window, and after final cleaning and adjustments have been made to window.

1.11 FIELD SAMPLE

A. Install actuator on one window unit to demonstrate compatibility and functional operation.

B. Install on a window unit that can easily be inspected from both sides.

C. Prepare and test field sample prior to installation of operators on other windows.

1.12 WARRANTY

A. Furnish manufacturer’s written warranty guaranteeing window actuator system materials and components to be free of defects for a period of not less than five years from date of Substantial Completion.

PART 2 -PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Dual Chain Actuator:

1. Basis-of-Design Product: Subject to compliance with requirements, provide ET-DCA3 by Northern Star Technologies.

B. Locking Actuator:

1. Basis-of-Design Product: Subject to compliance with requirements, provide ET-MPLA by Northern Star Technologies.

2.2 WINDOW ACTUATOR

A. Technical Features:
1. Actuator maintains inherent operating range of window.
2. Dual synchronous chain (2 motors, 2 gear assemblies, 2 chains).
3. Clutching or power disengagement capability shall prevent damage to window or window actuator due to occasional excessive operational force.
4. Pivoting universal mounting bracket system.
5. Maximum current absorption: 2.8 Amps.

B. Operation
1. Two motors and two chain design in a single housing.
   a. Low noise dual isolation enclosure.
2. Electronic overload cutoff limit stop, low noise operation; safety synchronization,
3. Lifting/closing force: 1000 N.
4. Static lock force: 8000 N.
5. Voltage supply: 24VDC.
6. Maximum push and pull force: 500 N.
7. Endurance tests: 10,000 cycles.

C. Materials:
1. All parts to be corrosion resistant.
2. Bearings: Self lubricating ball bearings.
3. Chain type: Stainless steel double link chain.

D. Finishes:
1. Dual chain actuator: Manufacturer’s standard.
   a. Basis-of-design: Anodized aluminum.
2. Sash or chassis brackets and adapters: Manufacturer’s standard.

E. Accessories:
1. Heavy duty drive for windows over 35 lbs and up to 55 lbs operating force.

F. Warranty: 5 years.

2.3 LOCKING ACTUATOR

A. Features:
   1. Hi-torque quiet belt drive mechanism.
   2. Flat mount 4-hole tabs.
   3. Electronic overload cutoff and limit stop.
   4. Maximum current absorption: 1.5 Amps.

B. Operation:
   1. Turning angle: 180 degrees.
   2. Lifting/closing force: 10 Nm.
   3. Voltage supply: 24VDC.
   4. Endurance tests: 10,000 cycles.

C. Materials:
   1. All parts to be corrosion resistant.

D. Finishes:
   1. Locking actuator: Manufacturer’s standard.
      a. Basis-of-design: White.

E. Warranty: 5 years.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and adjoining construction, and conditions under which Work is to be installed. Do not proceed with Work until unsatisfactory conditions are corrected.

B. Examine installed windows and determine that installation is complete and that windows are operating smoothly and compatible with all actuator system requirements.

3.2 PREPARATION

A. Protect adjacent surfaces not designated to receive actuators.

3.3 INSTALLATION

A. Installer shall have experience installing devices of the type specified.

B. Install actuators according to manufacturer's recommended instructions and approved shop drawings.

3.4 FIELD QUALITY CONTROL

A. After installation, test all windows and operators. Cycle open and closed a minimum of ten times. Verify the following:

1. Proper sash alignment in window frame.
2. Full opening and closing.
3. "Excessive force" electronic overload protection system.
4. Complete and tight gasket closure for weather tight window unit seal.

B. Correct deficiencies and make required actuator adjustments.

3.5 DEMONSTRATION

A. Demonstrate operation of window operator(s) to owner’s designated representative(s).

END OF SECTION 087650

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.
3. Glazed curtain walls.
4. Storefront framing.
5. Glazed entrances.
6. Interior borrowed lites.
7. Vacuum Insulation Panel.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4 and 16a-38k-4(b)5
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.
2. Section 086200 "Unit Skylights” for glazing in unit skylights
3. Section 088300 "Mirrors."
4. Section 088853 "Security Glazing" for glazing units resistant to ballistic attacks.

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, licensed in the State of Connecticut, using the following design criteria:

1. Design Wind Pressures: As indicated on Structural Drawings.
2. Design Snow Loads: As indicated on Structural Drawings.
3. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
4. Glass Type Factors for Acid Etched Glass:

   a. Short-Duration Glass Type Factor for Acid Etched: 0.5.
5. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.
6. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and <u>NOTICE TO CONTRACTOR – SUBMITTALS.</u>

B. Product Data: For each glass product and glazing material indicated.

C. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

D. Glazing Accessory Samples: For gaskets, sealants and colored spacers, in 12-inch (300-mm) lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

E. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

F. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer, licensed in the State of Connecticut, responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installers manufacturers of insulating-glass units with sputter-coated, low-e coatings, glass testing agency and] sealant testing agency.

B. Product Certificates: For glass and glazing products, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for coated glass, insulating glass, glazing sealants and glazing gaskets.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.

E. Warranties: Sample of special warranties.

1.7 QUALITY ASSURANCE SUBMITTALS

A. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.8 CLOSEOUT SUBMITTALS

A. Warranty: For Glazing specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

E. Source Limitations for Glass: Obtain coated float glass, laminated glass and insulating glass from single source from single manufacturer for each glass type.

F. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

H. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

I. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F (250 deg C), and the fire-resistance rating in minutes.

J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

K. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install glazing in mockups specified in Section 084113 "Aluminum-Framed Entrances and Storefronts" and Section 084413 "Glazed Aluminum Curtain Walls" to match glazing systems required for Project, including glazing methods.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

L. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.11 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C).

1.12 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: Five years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F (W/sq. m x K).
5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. For uncoated glass, comply with requirements for Condition A.
3. For coated vision glass, comply with requirements for Condition C (other coated glass).

A. Pyrolytic-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide coating applied by pyrolytic deposition process during initial manufacture, and complying with other requirements specified.

B. Sputter-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide or -nitride coating deposited by vacuum deposition process after manufacture and heat treatment (if any), and complying with other requirements specified.

C. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B, Type I, Quality-Q3, and complying with other requirements specified.

1. Glass: Clear float.
   Ceramic Coating Color: As selected by Architect from manufacturer's full range.

D. Tempered Acid Etched Glass: ASTM C 1048 Kind FT (fully tempered) , Type II, Class 1 (clear), Form 3; Quality-Q6, Finish F2 (etched both sides), [Pattern P3 (random)].

2.3 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written recommendations.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

B. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Laminated-Glass Types" Article.

2.4 INSULATING GLASS

1. Basis-of-Design Product: Subject to compliance with requirements, provide Sunglass, Old Castle Building Envelope.

B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

1. Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary.
2. Spacer: Box type, desiccant filled, perforated aluminum in color selected by Architect. Use of “U” shaped spaces (in cross section) is not permitted..
3. Desiccant: Molecular sieve or silica gel, or blend of both.

C. Glass: Comply with applicable requirements in "Glass Products" Article and in "Laminated Glass" Article as indicated by designations in "Insulating-Glass Types" Article and in "Insulating-Laminated-Glass Types" Article.

2.5 FIRE-PROTECTION-RATED GLAZING

A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies.

B. Film-Faced Ceramic Glazing: Clear, ceramic flat glass; 3/16-inch (5-mm) nominal thickness; faced on one surface with a clear glazing film; complying with testing requirements in 16 CFR 1201 for Category II materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Nippon Electric Glass Co., Ltd. (distributed by Technical Glass Products); FireLite NT.
b. Safti First; SuperLite C/SP.

c. Schott North America, Inc.; Filmed Pyran Star or Filmed Pyran Crystal.

2.6 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
3. Silicone complying with ASTM C 1115.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM, silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.7 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
b. Pecora Corporation; 890.
c. Sika Corporation, Construction Products Division; SikaSil-C990.

2. Applications: Exterior glazing where recommended by glazed product manufacturer.

C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. GE Advanced Materials - Silicones; SilGlaze II SCS2800 or SilPruf NB SCS9000 orSilPruf SCS2000 or UltraPruf II SCS2900.
    b. Pecora Corporation; 864 or895 or898].
    c. Sika Corporation, Construction Products Division; SikaSil-C995.

2. Applications: Exterior glazing where recommended by glazed product manufacturer.

D. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

H. Vacuum Insulation Panel: High efficiency insulation made of high performance inorganic fumed silica core material with aluminized multilayer barrier with thermal welded seams

1. Basis-of-Design Product: Vacuum Insulation Panel; Dow Corning.

a. Thickness: ½ inch.
b. R-Value: 39 per inch thickness.
c. Flamespread Index: 25 or less.
d. Smoke Developed Index: 20 or less.

2.10 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

2.11 LAMINATED-GLASS TYPES

A. Glass Type G5 and G7: Clear laminated glass with two plies of float glass.

a. Annealed or Kind HS (heat strengthened), if required, Kind FT (fully tempered), where indicated.

2. Thickness of Each Glass Ply: 3.0 mm.
3. Interlayer Thickness: 0.060 inch (1.52 mm).
4. One glass ply to be acid etched at glass type G5.
5. Provide safety glazing labeling.

2.12 INSULATING-GLASS TYPES

A. Glass Type G1: 1” insulated clear vision glass. Low-e-coated.

1. Overall Unit Thickness: 1 inch (25 mm).
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: Float glass.

a. Annealed or Kind HS (heat strengthened), if required, Kind FT (fully tempered), where indicated.

4. Interspace Content: Air or Argon.
5. Indoor Lite: Float glass.

a. Annealed or Kind HS (heat strengthened), if required, Kind FT (fully tempered), where indicated.

6. Low-E Coating: Pyrolytic or sputtered on second surface.
7. Visible Light Transmittance Outside: 8 percent minimum.
8. Visible Light Transmittance Inside: 11 percent minimum.
9. Winter Nighttime U-Factor: .29 maximum.
10. Summer Daytime U-Factor: .27 maximum.
11. Solar Heat Gain Coefficient: .25 maximum.
12. Provide safety glazing labeling.

B. Glass Type G2: 1” insulated spandrel glass. Ceramic-coated, low-e.

1. Overall Unit Thickness: 1 inch (25 mm).
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: Float glass.
   a. Annealed or Kind HS (heat strengthened), if required, Kind FT (fully tempered), where indicated.
4. Interspace Content: Vacuum Insulation Panel.Retain either heat-strengthened or fully tempered float glass option in first subparagraph below for ceramic-coated, low-e, insulating spandrel glass.
5. Indoor Lite: Float glass.
   a. Annealed or Kind HS (heat strengthened), if required, Kind FT (fully tempered), where indicated.
6. Low-E Coating: Pyrolytic or sputtered on second surface.
7. Opaque Coating Location: Second and third surface.
8. Winter Nighttime U-Factor: .29 maximum.
9. Summer Daytime U-Factor: .27 maximum.

2.13 INSULATING-LAMINATED-GLASS TYPES

A. Glass Type G4: 1 inch insulated safety glass. Low-e-coated, laminated glass.

1. Overall Unit Thickness: 1 inch (25 mm).
2. Thickness of Outdoor Lite: 6.0 mm.
   a. Outdoor Lite: Float Glass.
      1) Kind HS (heat strengthened), if required, Kind FT (fully tempered), where indicated.
3. Interspace Content: Air orArgon.
4. Indoor Lite: Clear laminated glass with two plies of float glass.
   a. Kind HS (heat strengthened), if required, Kind FT (fully tempered), where indicated.

   b. Thickness of Each Glass Ply: 3.0 mm.
   c. Interlayer Thickness: 0.060 inch (1.52 mm).

5. Low-E Coating: Pyrolytic or sputtered on second surface.
6. Visible Light Transmittance Outside: 8 percent minimum.
7. Visible Light Transmittance Inside: 11 percent minimum.
8. Winter Nighttime U-Factor: .29 maximum.
9. Summer Daytime U-Factor: .27 maximum.
10. Solar Heat Gain Coefficient: .25 maximum.
11. Provide safety glazing labeling.

2.14 FIRE-PROTECTION-RATED GLAZING TYPES

A. Glass Type G6: 120-minute fire-rated glazing; film-faced ceramic glazing.

1. Provide safety glazing labeling.

2.15 FIRE PROTECTION-RATED INSULATING-GLASS TYPES

A. Glass Type G8: 1” insulated fire protection rated glass. Low-e-coated.

1. Overall Unit Thickness: 1 inch (25 mm).
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: 60 minute fire rated glazing; film faced.
   a. Annealed or Kind HS (heat strengthened), if required, Kind FT (fully tempered), where indicated.
4. Interspace Content: Air or Argon.
5. Indoor Lite: 60 minute fire rated glazing; film faced.
   a. Annealed or Kind HS (heat strengthened), if required, Kind FT (fully tempered), where indicated.
6. Low-E Coating: Pyrolytic or sputtered on second surface.
7. Visible Light Transmittance Outside: 8 percent minimum.
8. Visible Light Transmittance Inside: 11 percent minimum.
9. Winter Nighttime U-Factor: .29 maximum.
10. Summer Daytime U-Factor: .27 maximum.
11. Solar Heat Gain Coefficient: .25 maximum.
12. Provide safety glazing labeling.

B. Glass Type G9: 1” insulated fire protection rated spandrel glass. Ceramic-coated, low-e.

1. Overall Unit Thickness: 1 inch (25 mm).
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: 60 minute fire rated glazing; film faced.
   a. Annealed or Kind HS (heat strengthened), if required, Kind FT (fully tempered), where indicated.
4. Interspace Content: Vacuum Insulation Panel.
5. Indoor Lite: 60 minute fire rated glazing; film faced.
   a. Annealed or Kind HS (heat strengthened), if required, Kind FT (fully tempered), where indicated.

6. Low-E Coating: Pyrolytic or sputtered on second surface.
7. Opaque Coating Location: Fourth surface.
8. Winter Nighttime U-Factor: .29 maximum.
9. Summer Daytime U-Factor: .27 maximum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK-STRIP GASKET GLAZING

A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system unless otherwise indicated.

3.8 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 088300 - MIRRORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following types of silvered flat glass mirrors:

1. Laminated glass mirrors qualifying as safety glazing.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.
2. Section 088000 "Glazing" for glass with reflective coatings used for vision and spandrel lites.
3. Section 102800 "Toilet, Bath, and Laundry Accessories" for metal-framed mirrors.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.

C. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachments to other work.

D. Samples: For each type of the following products:

1. Mirrors: 12 inches (300 mm) square, including edge treatment on two adjoining edges.
2. Mirror Trim: 12 inches (300 mm) long.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Mirrors to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

B. Warranty: For Mirrors specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

B. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.

C. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.

D. Glazing Publications: Comply with the following published recommendations:

1. GANA's "Glazing Manual" unless more stringent requirements are indicated. Refer to this publication for definitions of glass and glazing terms not otherwise defined in this Section or in referenced standards.
2. GANA Mirror Division's "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

E. Safety Glazing Products: For laminated mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which mirror manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SILVERED FLAT GLASS MIRRORS

A. Glass Mirrors, General: ASTM C 1503.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Arch Aluminum & Glass Co., Inc.
b. Guardian Industries.
c. Lenoir Mirror Company.

B. Laminated Mirrors: ASTM C 1172, Kind LM.

1. Clear Glass for Outer Lite: Mirror Select Quality.
2. Nominal Thickness for Outer Lite: 3.0 mm.
3. Glass for Inner Lite: Tempered float glass; ASTM C 1048 Type I; Quality-Q3; Class I (clear), Kind FT, Condition A.
4. Nominal Thickness: 3.0 mm.
5. Interlayer: Mirror manufacturer's standard 0.030-inch- (0.76-mm-) thick, clear polyvinyl-butyral interlayer with a proven record of showing no tendency to delaminate from, or cause damage to, silver coating.

2.2 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.

2.3 MIRROR HARDWARE

A. Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.

1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch (9.5 and 22 mm) in height, respectively, and a thickness of not less than 0.05 inch (1.3 mm).

   a. Basis-of-Design Product: Subject to compliance with requirements, provide CRL Standard "J" Channel; Laurence, C. R. Co., Inc.

2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch (16 and 25 mm) in height, respectively, and a thickness of not less than 0.062 inch (1.57 mm).

   a. Basis-of-Design Product: Subject to compliance with requirements, provide CRL Deep "J" Channel; Laurence, C. R. Co., Inc.

3. Finish: Clear bright anodized.

B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.4 FABRICATION

A. Mirror Sizes: To suit Project conditions, and before tempering, cut mirrors to final sizes and shapes.

B. Cutouts: Fabricate cutouts before tempering for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

C. Mirror Edge Treatment: Flat polished.

1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Verify compatibility with and suitability of substrates.

C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

B. Provide a minimum air space of 1/8 inch (3 mm) between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.

C. Wall-Mounted Mirrors: Install mirrors with mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

1. Top and Bottom Aluminum J-Channels: Provide setting blocks 1/8 inch (3 mm) thick by 4 inches (100 mm) long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch (6.4 mm) wide by 3/8 inch (9.5 mm) long at bottom channel.

3.4 CLEANING AND PROTECTION

A. Protect mirrors from breakage and contaminating substances resulting from construction operations.

B. Do not permit edges of mirrors to be exposed to standing water.

C. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

D. Wash exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 088300

SECTION 088853 - SECURITY GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes glazing for the following products and applications and of the following types:

1. Products and applications specified in other Sections where glazing requirements are specified by reference to this Section:

a. Security windows.

2. Security Glazing Types:

a. Laminated polycarbonate.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 088000 "Glazing" for non-security glazing in the form of monolithic glass, laminated glass, and insulating glass.

1.3 DEFINITIONS

A. Glazing Manufacturers: Firms that produce primary glass, monolithic plastic glazing, or fabricated security glazing, as defined in referenced glazing publications.

1.4 PERFORMANCE REQUIREMENTS

A. General:
   1. Installed security glazing shall withstand security-related loads and forces without damage to the glazing beyond that allowed by referenced standards.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glazing framing members and glazing components.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Security Glazing Samples: For each type of security glazing; 12 inches (300 mm) square.

D. Glazing Accessory Samples: For gaskets,, in 12-inch (300-mm) lengths.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturers of security glazing.

B. Product Certificates: For each type of product indicated, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of security glazing glazing gasket.

D. Warranties: Sample of special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Warranty: For Security Glazing specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.8 QUALITY ASSURANCE

A. Source Limitations for Security Glazing: Obtain security glazing from single source from single manufacturer using the same type of lites, plies, interlayers, and spacers for each security glazing type indicated.

B. Source Limitations for Glazing Gaskets: Obtain from single source from single manufacturer for each product and installation method.

C. Glazing Publications: Comply with published recommendations of security glazing and glazing material manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."

D. Plastic Glazing Labeling: Identify plastic sheets with appropriate markings of applicable testing and inspecting agency, indicating compliance with required fire-test-response characteristics.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect security glazing and glazing materials according to manufacturer's written instructions. Prevent damage from condensation, temperature changes, direct exposure to sun, or other causes.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F (4.4 deg C).

1.11 COORDINATION

A. Coordinate dimensions, including thickness, of security glazing with dimensions of construction that receives security glazing.

1.12 WARRANTY

A. Manufacturer's Special Warranty for Laminated Polycarbonate: Manufacturer's standard form in which laminated polycarbonate manufacturer agrees to replace laminated polycarbonate that deteriorates within specified warranty period. Deterioration is defined as defects developed from normal use that are not attributed to maintaining and cleaning laminated polycarbonate contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glazing, blemishes exceeding those allowed by referenced standard, yellowing, and loss of light transmission.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SECURITY GLAZING, GENERAL

A. Thickness: Where thickness is indicated, it is a minimum. Provide security glazing in thicknesses as needed to comply with requirements indicated.

B. Fire-Test-Response Characteristics of Plastic Sheets: As determined by testing plastic sheets identical to those used in security glazing products by a qualified testing agency acceptable to authorities having jurisdiction.

1. Self-ignition temperature of 650 deg F (343 deg C) or more when tested per ASTM D 1929 on plastic sheets in thicknesses indicated for the Work.
2. Smoke-developed index of 450 or less when tested according to ASTM E 84, or smoke density of 75 or less when tested per ASTM D 2843 on plastic sheets in thicknesses indicated for the Work.
3. Burning extent of 1 inch (25 mm) or less when tested per ASTM D 635 at a nominal thickness of 0.060 inch (1.52 mm) or thickness indicated for the Work.

2.2 POLYCARBONATE SECURITY GLAZING

A. Polycarbonate Sheet: ASTM C 1349, Appendix X1, Type II, coated, mar-resistant, UV-stabilized polycarbonate with coating on exposed surfaces and Type I, standard, UV-stabilized polycarbonate where no surfaces are exposed.

B. Laminated Polycarbonate: Polycarbonate sheets laminated with clear urethane interlayer that complies with ASTM C 1349, Appendix X2, and has a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation. Provide laminated units that comply with requirements of ASTM C 1349 for maximum allowable laminating process blemishes and haze.

2.3 SPALL-RESISTANT FILM

A. Spall-Resistant Film: Composite of clear polyvinyl butyral film and clear abrasion-resistant polyester film.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. DuPont Glass Laminating Solutions, DuPont Company; SpallShield.

B. Laminating Process: Laminate spall-resistant film to glazing assemblies in factory to produce laminated lites free of foreign substances, air, and glass pockets.

2.4 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
3. Silicone complying with ASTM C 1115.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM, silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.5 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; non-staining and non-migrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and security glazing manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of security glazing and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by security glazing manufacturer to maintain security glazing lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit security glazing lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.7 FABRICATION OF SECURITY GLAZING

A. Fabricate security glazing in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of

product manufacturer and referenced glazing publications, to comply with system performance requirements.

2.8 LAMINATED-POLYCARBONATE SECURITY GLAZING TYPES

A. Security Glazing : Laminated polycarbonate.

1. Forced-Entry Resistance: Level III per U.L..
2. Number of Plies: Four.
3. Overall Unit Thickness: 1.125 inches.
4. Outer and Inner Plies: 0.125-inch polycarbonate.
5. Core Plies: 0.5 inch polycarbonate.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing for security glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving security glazing immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of security glazing, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect edges of security glazing from damage during handling and installation. Remove damaged security glazing from Project site and legally dispose of off Project site. Damaged security glazing includes units with edge or face damage or other imperfections that, when installed, could weaken security glazing, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glazing unit manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by security glazing manufacturers for installing lites.

F. Provide spacers for security glazing lites where the length plus width is larger than 50 inches (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of security glazing. Install correct size and spacing to preserve required face clearances unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with performance requirements.
2. Provide 1/8-inch (3-mm) minimum bite of spacers on glazing lites and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent security glazing from moving sideways in glazing channel, as recommended in writing by security glazing manufacturer and according to requirements in referenced glazing publications.

H. Set security glazing in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set coated security glazing with proper orientation so that coatings face exterior or interior as specified.

J. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by security glazing, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Center security glazing in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket securely in place between glazing unit and frame or fixed stop, with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center security glazing in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in security glazing. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center security glazing in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in security glazing. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 PROTECTION AND CLEANING

A. Protect exterior security glazing from damage immediately after installation by attaching crossed streamers to framing held away from glazing unit. Do not apply markers to security glazing surfaces. Remove nonpermanent labels, and clean surfaces.

B. Protect security glazing from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with security glazing, remove substances immediately as recommended in writing by security glazing manufacturer.

C. Examine security glazing surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by security glazing manufacturer.

D. Remove and replace security glazing that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, or vandalism during construction period.

E. Wash security glazing on exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash security glazing as recommended in writing by security glazing manufacturer.

END OF SECTION 088853

SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum louvers.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).

C. Vertical Louver: Louver with vertical blades (i.e., the axes of the blades are vertical).

D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

E. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

C. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

D. Samples: For each type of metal finish required.

E. Delegated-Design Submittal: For louvers indicated to comply with structural**and seismic** performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

B. Windborne-debris-impact-resistance test reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Structural Drawings.

B. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Component Importance Factor: Refer to Structural Drawings..

C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Drainable-Blade Louver :

1. Basis-of-Design Product: Subject to compliance with requirements, provide ELF6375DX; Ruskin Company.
2. Louver Depth: 6 inches (150 mm.
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm) for blades and 0.080 inch (2.03 mm) for frames].
4. Mullion Type: Exposed.
5. Louver Performance Ratings:

   a. Free Area: Not less than 57%.
   b. Point of Beginning Water Penetration: Not less than 1023 fpm..
   c. Air Performance: Not more than 0.13-inch wg static pressure drop at 1000-fpm free-area exhaust velocity.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening.

B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:

1. Bird Screening: Flattened, expanded aluminum, 3/4 by 0.050 inch (19 by 1.27 mm) thick.
2. Insect Screening: Aluminum, 18-by-16 (1.4-by-1.6-mm) mesh, 0.012-inch (0.30-mm) wire.

2.5 MATERIALS

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For color-finished louvers, use fasteners with heads that match color of louvers.

D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
1. Horizontal Mullions: Provide horizontal mullions at joints.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Channel unless otherwise indicated.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less.

1. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.

G. Provide subsills made of same material as louvers or extended sills for recessed louvers.

H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view , threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.7 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weather tight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089119

SECTION 092116.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Gypsum board shaft wall assemblies to be used in a horizontal application.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-4(d)9 and 16a-38k-4(d)11.
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each component of gypsum board shaft wall assembly.

1.4 QUALITY ASSURANCE SUBMITTALS

A. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

A. Fire-Resistance Rating: 1 hour.

B. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.

1. Depth: As indicated.
2. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).

C. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches (51 mm) long and matching studs in depth.

1. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).

D. Firestop Tracks: Provide firestop track at head of shaft wall on each floor level.

E. Room-Side Finish: Gypsum board.

F. Shaft-Side Finish: Gypsum shaftliner board, Type X.

2.3 PANEL PRODUCTS

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

B. Gypsum Shaftliner Board, Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Georgia-Pacific Gypsum LLC, Subsidiary of Georgia Pacific; ToughRock Fireguard Shaftliner.
b. National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner.
c. USG Corporation; Sheetrock Brand Gypsum Liner Panel.

2. Thickness: 1 inch (25.4 mm).
3. Long Edges: Double bevel.

C. Gypsum Board: As specified in Section 092900 "Gypsum Board."

2.4 NON-LOAD-BEARING STEEL FRAMING

A. Steel Framing Members: Comply with ASTM C 645 requirements for metal unless otherwise indicated.

1. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with manufacturer's written recommendations.

B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written recommendations for application indicated.

C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing according to ASTM E 488 conducted by a qualified testing agency.
2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing according to ASTM E 1190 conducted by a qualified testing agency.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which gypsum board shaft wall assemblies attach or abut Examine for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 other than stud-spacing requirements.

B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.

C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, heavy trim and similar items that cannot be supported directly by shaft wall assembly framing.

D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, and similar items.

E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.

F. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.3 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092116.23

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(d)9 and 16a-38k-4(d)11
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 054000 “Cold-Formed Metal Framing” for exterior non-load-bearing wall studs.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For firestop tracks, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Installer’s Qualifications:

1. Minimum of 2 successive years successfully installing gypsum wallboard.
2. Successfully completed projects of similar magnitude.

B. Compatibility: To assure compatibility, studs, runner track, clips, etc., shall be the products of same manufacturer, unless otherwise indicated.

1.6 DELIVERY, HANDLING AND STORAGE

A. All materials shall be delivered in original packages, containers or bundles bearing brand name, applicable standard designation, and name of manufacturer of product manufactured.

B. All materials shall be kept dry by storing inside building under roof. P

PART 2 - RODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 FRAMING SYSTEMS

A. Manufacturers; Subject to compliance with requirements, provide products of one of the following:
   1. Metal-Lite
   2. Clark Dietrich Building Systems
   3. Marino\Ware

B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

   1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
   2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.

C. Studs and Runners: ASTM C 645.

   1. Steel Studs and Runners:

      a. Minimum Base-Metal Thickness: 0.033 inch (21 gauge, 0.84 mm).
      b. Depth: As indicated on Drawings.

D. Slip-Type Head Joints: Where indicated, provide the following:
   1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

      a. Products: Subject to compliance with requirements, provide one of the following:

1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
2) MBA Building SuppliesSlotted Deflecto Track.
3) Telling Industries; Vertical Slip Trackor Vertical Slip Track II.

E. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Fire Trak Corp.; Fire Trak System attached to studs with Fire Trak Posi Klip.
b. Metal-Lite, Inc.; The System.
c. Dietrich Metal Framing; SLP-TRK.

F. Partition Reinforcement: Steel sheet for blocking, minimum 6” high, unless otherwise noted.

1. Minimum Base-Metal Thickness: .0747 inch (14 gauge, 1.8 mm)
2. Provide metal partition reinforcement for attachment of wall supported materials, including but not limited to toilet accessories, grab bars, corridor railings, millwork, shelving, etc.
3. Reinforcement for grab bars and corridor railings shall comply with ADA requirements, capable of supporting at least 250 pound point load. Reinforcement for other wall hung items such as cabinets/ casework, shelving, heavy trim, toilet accessories, etc. shall be capable of supporting a load of 144 lbs.lin ft.

G. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: 1-1/2 inches (38 mm).
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (15 gauge, 1.72-mm-) thick, galvanized steel.

H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.033 inch (21 gauge, 0.84mm).
2. Depth: As indicated on Drawings.

I. Cold-Rolled Furring Channels: 0.053-inch (17 gauge, 1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: As indicated on Drawings.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (21 gauge, 0.84 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (16 gauge, 1.59-mm-) diameter wire, or double strand of 0.048-inch- (18 gauge, 1.21-mm-) diameter wire.

J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.018 inch (0.45 mm), and depth as shown.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 16 guage diameter wire.

B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 8 guage in diameter.

C. Flat Hangers: ASTM A653, G40, sized as required to resist wind loads for exterior soffits..

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 17 gauge and minimum 1/2-inch- (13-mm-) wide flanges.

1. Depth: Min. 1-1/2 inches (38 mm).

E. Furring Channels (Furring Members):

1. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.

a. Minimum Base-Metal Thickness: 21 gauge.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide- one of- the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), non-perforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building

structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
   2. Installation shall conform to requirements specified in this section and the manufacturer's written instructions and recommendations.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

   1. Single-Layer Application: Install framing system components in strict accordance with manufacturers written requirements..
   2. Multilayer Application: Install framing system components in strict accordance with manufacturers written requirements. .
   3. Tile Backing Panels: Install framing system components in strict accordance with manufacturers written requirements. .

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. All studs secured with screws through both flanges at studs and runners, except as detailed at slip joints and deflection/fire stop track.

E. Partitions 10 feet or more in height shall be braced horizontally with 3/4" channels wired to inside of each stud. Maximum spacing of horizontal bracing 6'-0" on center.

F. Partition Reinforcement: Install partition reinforcement as hereinbefore specified for attachment of wall-hung items. Attach to studs with screws as recommended by the reinforcement manufacturer.

G. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to

terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies. Leave ¾ inch space between tops of studs and deck.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

   a. Install two studs at each jamb unless otherwise indicated.
   b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
   c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

   a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

H. Direct Furring:
   1. Attach to concrete or masonry with drilled-in or expansion anchors at spacing recommended by the manufacturer..

I. Z-Furring Members:

   1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-furring members spaced at 16 inches (406 mm) o.c.
   2. Except at exterior corners, securely attach narrow flanges of furring members to wall with drilled-in or expansion anchors at spacing recommended by the manufacturer.
   3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

J. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

K. Interior Soffit Framing Installation:

1. Hang soffit framing by attaching directly to overhead structure or provide overhead structure as required to support soffit framing.
2. Space soffit framing 16 inches O.C. unless otherwise indicated.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings as required by referenced installation standards for assembly types and other assembly components indicated.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail. Where no such structures or devices exist, provide supplemental framing and devices sized and spaced to adequately support ceiling loads.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail. Provide supplemental framing as required.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
9. Incorporate isolation hangers into hanger wires where indicated.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

F. Installation Tolerances: Install suspension systems that are level to within -1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.6 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instruction and applicable requirements of ASTM C840.

B. Control Joints: Install control joints at locations indicated on Drawings. Where not shown on Drawings, install control joints according to ASTM C840 and in specific locations approved by Architect for visual effect.

C. Cornerbeads: Install at all outside corners:

D. Casing Beads: Install at gypsum board edges where boards abut other materials.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-4(d)9 and 16a-38k-4(d)11
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 055000 "Metal Fabrications" for installing expanded wire mesh.
3. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
4. Section 092216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1.4 QUALITY ASSURANCE SUBMITTALS

A. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

B. All materials shall be delivered in original packages, containers or bundles bearing brand name, applicable standard designation and name of manufacturer or product manufactured.

C. Comply with GA-216 and manufacturers written recommendations.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Georgia-Pacific Gypsum LLC.
   2. National Gypsum Company.
   3. USG Corporation.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.

   1. Thickness: 5/8 inch (15.9 mm).
   2. Long Edges: Tapered.

C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

   1. Thickness: 1/2 inch (12.7 mm).
   2. Long Edges: Tapered.
   3. Sag Resistant.

D. Foil-Backed Gypsum Board: ASTM C 1396/C 1396M.

   1. Core: 5/8 inch (15.9 mm), Type X.
   2. Long Edges: Tapered.

E. Abuse-Resistant Gypsum Board: ASTM C 1629/C 1629M, Level 3.

   1. Core: 5/8 inch (15.9 mm), Type X.
   2. Long Edges: Tapered.
   3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

F. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

   1. Core: 5/8 inch (15.9 mm), Type X.
   2. Long Edges: Tapered.
   3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.

   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Custom Building Products; Wonderboard.
      b. National Gypsum Company, Permabase Cement Board.
      c. USG Corporation; DUROCK Cement Board.

   2. Thickness: 5/8 inch (15.9 mm).
   3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

    a. Cornerbead.
    b. Bullnose bead.
    c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    d. L-Bead: L-shaped; exposed long flange receives joint compound.
    e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    f. Expansion (control) joint.
    g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Structural Laminate Drywall Corner: ASTM C 1047, NFPA Class A, UBC Class 1 when tested in accordance with ASTM E84 with a flame spread index of 5 and smoke density index of 100.

1. Basis of Design Product: Subject to compliance with requirements, provide, No-Coat; Structus Building Technologies.

2. Material: Copolymer core, tight fibered paper surface, joint paper back.
3. Shapes:

    a. Outside cornerbead.
4. Accessories: Transition caps and corner caps

C. Exterior Trim: ASTM C 1047.

1. Material: -Hot-dip galvanized steel sheet, - or rolled zinc .
2. Shapes:

    a. Cornerbead.
    b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.

2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping and or drying-type, all-purpose compound.

    a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping and / or drying-type, all-purpose compound.
4. Finish Coat: For third coat, use setting-type, sandable topping and / or drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound and / or drying-type, all-purpose compound.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Acoustical Joint Sealant: Refer to Division 07 Section “Joint Sealants.

E. Thermal and Sound Attenuation Blanket Insulation: As specified in Section 072100 "Thermal Insulation."

F. Vapor Retarder: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Refer to drawings for gypsum panel applications above ceilings.
   2. Fit gypsum panels around ducts, pipes, and conduits.
   3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Sound Rated Assemblies (STC-Rated Assemblies): Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

1. Unless otherwise indicated, provide STC 50 rated assemblies.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: As indicated on Drawings.
2. Type X: Where required for fire-resistance-rated assembly.
3. Ceiling Type: Ceiling surfaces.
4. Foil-Backed Type: at exterior walls and where indicated.
5. Abuse-Resistant Type: As indicated on Drawings.
6. Moisture- and Mold-Resistant Type: Install at damp areas such as Toilet Rooms, Janitor’s Closets and Utility Rooms and where indicated.
7. Cementitious Backer Units: Install at showers, tubs and other wet areas.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches (400 mm) minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten layers in accordance with the manufacturers written recommendations

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.

1. Install with 1/4-inch (6.4-mm) open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

3.5 APPLYING TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A108.11, at showers, tubs, and where indicated.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.6 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. Bullnose Bead: Use where indicated.
3. LC-Bead: Use at exposed panel edges.
4. L-Bead: Use where indicated.
5. U-Bead: Use at exposed panel edges.
6. Curved-Edge Cornerbead: Use at curved openings.

D. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.

3.7 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile or acoustical tile.
3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.8 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 092910 – ALUMINUM PARTITION CLOSURE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

1.2 SUMMARY

A. Section includes noise control components.

B. Related Sections include the Following:

1. Division 7 Section “Thermal Insulation” for sound attenuation-insulation.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Manufacturer’s Literature and Data:

1. Product Data: Submit manufacturer’s technical data and brochures for each type of specified component required, including detail drawings, and installation instructions.

C. Shop Drawings:

1. Shop drawings shall show dimensions, sizes, thickness, alloys, tempers, finishes, joining, attachments, and relationship of adjoining work.

D. Samples:

1. Samples shall include three, 12” samples of each type of Mullion Mate partition closure and finish as specified and accessories.

E. Certification:

1. Submit certification from manufacturer of accessory attesting that products comply with specified requirements including finish as specified.

F. Qualification Data:

1. Firms specified in “Quality Assurance” Article must demonstrate their capabilities and experience by including lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.4 QUALITY ASSURANCE

A. Manufacturer: Firm with manufacturing and delivery capacity required for the project, shall have successfully completed at least ten projects within the past five years, utilizing systems, materials and techniques as herein specified.

B. Fabricator must own and operate its own manufacturing facilities for all metal components. Systems consisting of components from a variety of manufacturers will not be considered or accepted.

C. Manufacturer/Fabricator must own and operate its own Painting and Finishing facility to assure single source responsibility and quality control.

1.5 DELIVERY, STORAGE & HANDLING

A. All materials shall be protected during fabrication, shipment, site storage and erection to prevent damage from other trades. Store accessories inside a well-ventilated area, away from uncured concrete and masonry, and protected from the weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis of Design Product: Subject to compliance wit requirements, provide MULLION MATE; Gordon Interior Specialties Division, Gordon, Inc.

2.2 SYSTEMS DESCRIPTION

A. Pre-assembled and spring loaded extruded aluminum partition closures to provide tight fit at vertical junctures of partitions and window walls. Sound tested equal to 38 STC rating with acoustical batt sound attenuation.

2.3 MATERIALS

A. Aluminum extrusions: 6063-T5 temper, tensile strength 31 KSI (ASTM B 221, ASTM B 221 M).

B. Accessories: Acoustical Batts for sound attenuation (as specified).

C. General: Provide metals free from surface blemishes where exposed to view in finished unit. Surfaces that exhibit pitting, seam marks, roller marks, stains, and discolorations, or other imperfections on finished units are not acceptable. All metal shall be of the highest-grade commercial type.

2.4 FABRICATION

A. Provide extruded aluminum partition enclosures in maximum lengths to provide the least amount of joints and size to fit specified openings.

2.5 FINISHES

A. Acrylic-Polyester hybrid powder coat paint finish.

1. Custom color to match window wall.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examination of Surfaces: Installer must examine conditions under which work is to be performed and must notify contractor in writing of unsatisfactory conditions.

B. Verify that field measurements and block-out dimensions are as shown on shop drawings.

3.2 CLEANING

A. Clean all surfaces following installation. If necessary use only a mild soap or detergent solution such as TSP-90 or Ivory.

3.3 PROTECTION

A. Protect the finished work from damage during the remainder of the construction period.

B. Damage to finished work: Finished units shall be without damage. Damage shall be repaired by the sub-contractor.

END OF SECTION 092910

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Ceramic tile.
2. Stone thresholds.
3. Waterproof membrane.
4. Metal edge strips.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
3. Section 092900 "Gypsum Board" for tile backer panels.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."

C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum .06 (wet).

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

D. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

E. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Full-size units of each type of trim and accessory for each color and finish required.
3. Stone thresholds in 6-inch (150-mm) lengths.
4. Metal edge strips in 6-inch (150-mm) lengths.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each type of product, signed by product manufacturer.

C. Material Test Reports: For each tile-setting and -grouting product.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 QUALITY ASSURANCE SUBMITTALS

A. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.9 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of each type from one source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:

1. Stone thresholds.
2. Waterproof membrane.
3. Joint sealants.
4. Metal edge strips.

D. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.11 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

2.2 TILE PRODUCTS

A. Tile Type (QT-1): Unglazed square-edged quarry tile.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Quarry Naturals; American Olean; Division of Dal-Tile International Inc.

2. Face Size: 8 by 3-7/8 inches (203 by 98 mm).
3. Thickness: 1/2 inch (12.7 mm).
4. Wearing Surface: Nonabrasive, smooth.
5. Tile Color and Pattern Basis-of-Design: Shadow gray (N46); American Olean; Division of Dal-Tile International Inc.
6. Grout Color: As selected by Architect from manufacturer's full range.
7. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

a. Base: Coved, face size 5 by 6 inches (127 by 152 mm). Provide cove corner and inside corner where applicable.

B. Tile Type (CT): Glazed wall and floor tile.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Urban Tones; American Olean; Division of Dal-Tile International Inc.

2. Composition: Porcelain.
3. Face Size: 6 by 18 inches (152 by 457 mm).
4. Thickness: 5/16 inch.
5. Face: Plain with square or cushion edges
6. Finish: Match basis of design product.
7. Tile Color and Pattern: As indicated on drawings.

8. Grout Color: As selected by Architect from manufacturer's full range.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Base Cove: Cove, module size 6 inches by 12 inches.
    b. Cove Base Outside Corner: Cove module size 1 inch x 6 inches.

2.3 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

    1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.

B. Granite Thresholds: ASTM C 615, with polished finish.

    1. Description: Uniform, fine-grained, gray stone without veining.
    2. Description: Match Architect's sample.

2.4 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.

    1. Products: Subject to compliance with requirements, provide one of the following:

        a. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
        b. Laticrete International, Inc.; Laticrete 9235 Waterproof Membrane.
        c. MAPEI Corporation; Mapelastic HPG with MAPEI Fiberglass Mesh.

2.5 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.

    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        a. Custom Building Products.
        b. Laticrete International, Inc.
        c. MAPEI Corporation.

2. Provide prepackaged, dry-mortar mix combined with acrylic resin liquid-latex additive at Project site.
3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.6 GROUT MATERIALS

A. Polymer-Modified Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Custom Building Products.
   b. Laticrete International, Inc.
   c. MAPEI Corporation.

2. Polymer Type: Acrylic resin in liquid-latex form for addition to prepackaged dry-grout mix.

2.7 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips (Floor): Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.

C. Metal Edge Protection (Wall): Outside corner made with trapezoid-perforated anchoring leg that is secured in the mortar bond coat beneath the tile, and an 87° sloped vertical wall section that provides a decorative finish and protects adjacent tiles.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Jolly; Schluter Systems, L.P.

2. Color: Brushed Nickel Anodized Aluminum.
3. Height: As required.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.8 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 TILE INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:

   a. Tile floors in wet areas.
   b. Tile floors composed of tiles 8 by 8 inches (200 by 200 mm) or larger.
   c. Tile floors composed of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Jointing Pattern: Lay tile in pattern indicated on drawings. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Quarry Tile: 3/8 inch (9.5 mm).
2. Floor Tile: 1/4 inch (6.35 mm).
3. Wall Tile: 1/16 inch (1.6 mm).

G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
   1. Do not extend waterproofing under thresholds set in latex-portland cement mortar. Fill joints between such thresholds and adjoining tile set on waterproofing with elastomeric sealant.

J. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

K. Metal Edge Protection: Install at all outside corners of tiles surfaces.

3.4 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.5 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

   1. Remove latex-portland cement grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
   3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.6 INTERIOR TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Tile Installation F113: Thin-set mortar; TCA F113.
   a. Thin-Set Mortar: Latex- portland cement mortar.
   b. Grout: Polymer-modified unsanded grout.

2. Tile Installation F122: Thin-set mortar on waterproof membrane; TCA F122.
   a. Thin-Set Mortar: Latex- portland cement mortar.
   b. Grout: Polymer-modified unsanded grout.

B. Interior Wall Installations, Masonry:

1. Tile Installation W202: Thin-set mortar; TCA W202.
   a. Thin-Set Mortar: Latex- portland cement mortar.
   b. Grout: Polymer-modified unsanded grout.

C. Interior Wall Installations, Metal Studs or Furring:

1. Tile Installation W243: Thin-set mortar on gypsum board; TCA W243.
   a. Thin-Set Mortar: Latex- portland cement mortar.
   b. Grout: Polymer-modified unsanded grout.

2. Tile Installation W244: Thin-set mortar on cementitious backer units; TCA W244.
   a. Thin-Set Mortar: Latex- portland cement mortar.
   b. Grout: Polymer-modified unsanded grout.

D. Shower Receptor and Wall Installations, Metal Studs or Furring:

1. Tile Installation B421: Thin-set mortar on waterproof membrane over cementitious backer units or fiber cement underlayment; TCA B421.
   a. Thin-Set Mortar: Latex-portland cement mortar.
   b. Grout: Polymer-modified unsanded grout.

END OF SECTION 093000

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Acoustical panels and exposed suspension systems for ceilings.
2. Acoustic Baffles.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4, 16a-38k-4(d)9, 16a-38k-4(d)11 and 16a-38k-4(b)2
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- (150-mm-) long Samples of each type, finish, and color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Acoustical Panel Ceilings to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
3. Hold-Down Clips: Equal to 2 percent of quantity installed.
4. Impact Clips: Equal to 2 percent of quantity installed.

1.8 QUALITY ASSURANCE SUBMITTALS

A. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.9 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of typical ceiling area as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.11 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
   a. Flame Spread Rating: 25 per ASTM E84.
2. Smoke-Developed Index: 50 or less, per ASTM E84.

C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ACOUSTICAL PANELS, GENERAL

A. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
2. Suspension System: Obtain each type from single source from single manufacturer.

B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.

C. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.

D. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.

E. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACOUSTICAL PANELS (ACT-1)

A. Basis-of-Design Product: Subject to compliance with requirements, provide Cirrus High CAC No. 572; Armstrong World Industries, Inc.

B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:

1. Type and Form: Type III, mineral base with painted finish; Form 1, nodular.
2. Pattern: E (lightly textured).

C. Color: White.

D. LR: Not less than 0.75.

E. NRC: Not less than 0.70.

F. CAC: Not less than 35.

G. Edge/Joint Detail: Angled tegular..

H. Thickness: 7/8 inch (22 mm).

I. Modular Size: 24 by 24 inches (610 by 610 mm).

J. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 ACOUSTICAL PANELS (ACT-2)

A. Basis-of-Design Product: Subject to compliance with requirements, provide Techzone, Optima, No. 1411 and No.3277; Armstrong World Industries, Inc.

B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
   1. Type and Form: Type XII, glass-fiber base with membrane-faced overlay; Form 2,
   2. Pattern: E (lightly textured).

C. Color: White.

D. LR: Not less than 0.90.

E. NRC: Not less than 0.90.

F. AC: Not less than 180.

G. Edge/Joint Detail: Square tegular..

H. Thickness: 1 inch (25 mm).

I. Modular Size:

   1. ACT4 by 60 inches (102 by 1525 mm).
   2. ACT - 20 by 60 inches (508 by 1525 mm).

J. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.5 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.

B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

   1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
   2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.

D. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.

E. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.6 METAL SUSPENSION SYSTEM (ACT-1)

A. Basis-of-Design Product: Subject to compliance with requirements, provide Prelude Plus XL HRC (High Recycled Content); Armstrong World Industries, Inc.

B. Wide-Face, Capped, Double-Web, Hot-Dip Galvanized, G60 (Z180), Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; hot-dip galvanized according to ASTM A 653/A 653M, G60 (Z180) coating designation; with prefinished, cold-rolled, 15/16-inch- (24-mm-) wide aluminum caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. Face Design: Flat, flush.
3. Face Finish: Painted white.

2.7 METAL SUSPENSION SYSTEM (ACT-2)

A. Basis-of-Design Product: Subject to compliance with requirements, provide Suprafine XL; Armstrong World Industries, Inc.

B. Narrow-Face, Steel-Capped, Double-Web, Fire-Rated Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished, cold-rolled, 9/16-inch- (15-mm-) wide metal caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. Face Design: Flat, flush.
   Cap Finish: Painted white.

2.8 METAL EDGE MOLDINGS AND TRIM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong World Industries, Inc.
2. Chicago Metallic Corporation.
3. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:

1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 (ASTM B 221M) for Alloy and Temper 6063-T5.
2. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.9 ACOUSTIC BAFFLES

A. Fabric-Wrapped Ceiling Panel: Manufacturer's standard panel construction consisting of facing material laminated to front face, edges, and back edge border of core or stretched over front face of edge-framed core and bonded or attached to edges and back of frame.

1. Basis-of-Design Product: Subject to compliance with requirements, provide AlphaEnviro Baffles; Acoustic Soultions.

2. Core: Glass-Fiber Board: ASTM C 612; Type standard with manufacturer; nominal density of 6 to 7 lb/cu. ft. (96 to 112 kg/cu. m), unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84.
3. Edge Profile: Square.
4. Edge Construction: Heat sealed.
5. Corner Detail in Elevation: Square.
6. Facing Material: 2 mil. PVC.
7. Nominal Thickness: 1 inch (25 mm).
8. Panel Width: 48 inches (1220 mm).
9. Panel Height: 24 inches (610 mm).
10. NRC: .85
11. Suspension Provisions: Nickel plated grommets.
12. Color: As selected by Architect from manufacturer’s full range.

2.10 ACOUSTICAL SEALANT

A. Products: Refer to Division 07 Section “Joint Sealants”.

2.11 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings and fabric wrapped panels attach or abut, with Installer present, for compliance

with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels and fabric wrapped panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

2.12 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

2.13 INSTALLATION (ACOUSTIC CEILINGS)

A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
6. Do not attach hangers to steel deck tabs.
7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
8. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
9. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:

a. Install panels with pattern running in one direction parallel to long axis of space.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
6. Install hold-down clips , in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated. Install impact clips at all Vestibules that lead to the exterior.
7. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

2.14 INSTALLATION (ACOUSTIC BAFFLES)

A. Install fabric-wrapped ceiling panels in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other panels and faces flush.

B. Comply with fabric-wrapped, ceiling panel manufacturer's written instructions for installation of panels using type of mounting devices indicated. Mount panels securely to supporting substrate.

C. Align and level fabric pattern and grain among adjacent panels.

2.15 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.

1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.

a. Within each test area, testing agency will select one of every 10 power-actuated
b. When testing discovers fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

C. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

2.16 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient base.
2. Resilient molding accessories.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long.

D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE SUBMITTALS

A. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C)or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burke Mercer Flooring Products, Division of Burke Industries Inc.
2. Flexco.
3. Roppe Corporation, USA.

B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

1. Style and Location:

a. Style A, Straight: Provide in areas with carpet.
b. Style B, Cove: Provide in areas with resilient flooring.
c. Style C, Butt to: Provide in areas indicated.

C. Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Colors:
   1. RB-1: Equal to Charcoal, No.123; Roppe Corporation.
      RB-2: Equal to Black, No. 100; Roppe Corporation.

2.2 RUBBER MOLDING ACCESSORY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Roppe Corporation, USA.
   2. VPI, LLC, Floor Products Division.
   3. Burke Mercer Flooring Products, Division of Burke Industries Inc.

B. Description: Rubber cap for cove carpet, cap for cove resilient flooring, carpet bar for tackless installations, carpet edge for glue-down applications, nosing for carpet, nosing for resilient flooring, reducer strip for resilient flooring, joiner for tile and carpet, and transition strips**,** as required..

C. Profile and Dimensions: As indicated.

D. Locations: Provide rubber molding accessories in areas indicated.

E. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.

   a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.

   a. Miter or cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from exposed surfaces.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Vinyl composition floor tile.

B. Related Requirements:

   1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4
      a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

C. Product Schedule: For floor tile. Use same designations indicated on Drawings**.**

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Resilient Tile Flooring to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box of each type, color, and pattern of floor tile installed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.9 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 VINYL COMPOSITION FLOOR TILE (VCT-1 and VCT-2)

A. Basis of Design Product: Subject to compliance with requirements,provide, Armstrong World Industries, Inc.

B. Tile Standard:
   1. VCT-1: ASTM F 1066, Class 2, through-pattern tile.
   2. VCT-2: ASTM F 2982.

C. Wearing Surface: Smooth.

D. Thickness: 0.125 inch (3.2 mm).

E. Size:
   1. VCT-1: 12 by 24 inches (305 by 610 mm).
   2. VCT-2: 12 by 12 inches (303 by 305 mm).

F. Colors and Patterns:
   1. VCT-1: Raffia; 55802 Charcoal Dust.
   2. VCT-2: Migrations; T3501 Platinum Gray.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

   1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:

    a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain running in one direction.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply two coat(s).

E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096536 - STATIC-CONTROL RESILIENT FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Static-dissipative, vinyl composition floor tile.

B. Related Requirements:

C. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 096513 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with static-control resilient flooring.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to static-control resilient flooring including, but not limited to, the following:

   a. Examination and preparation of substrates to receive static-control resilient flooring.
   b. Installation.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

C. Shop Drawings: For each type of static-control resilient flooring. Include floor-covering layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.
2. Show locations of inscribed maintenance tiles.
3. Submit grounding diagram showing location of grounding strips and connections.

D. Samples for Initial Selection: For each type of static-control resilient flooring.

E. Samples for Verification: For each type of static-control resilient flooring, of size indicated below:

1. Floor Tile: Full-size units.

F. Product Schedule: For static-control resilient flooring. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for static-control resilient flooring.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Static-Control Resilient Flooring to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for static-control resilient flooring.

1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store static-control resilient flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1. Floor Tile: Store on flat surfaces.

1.10 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 85 deg F (29 deg C), in spaces to receive static-control resilient flooring during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Close spaces to traffic during static-control resilient flooring installation.

D. Close spaces to traffic for 48 hours after static-control resilient flooring installation.

E. Install static-control resilient flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Static-Dissipative Properties: Provide static-control resilient flooring with static-control properties indicated as determined by testing identical products per test method indicated by an independent testing and inspecting agency.

1. Electrical Resistance: Test per ASTM F 150 with 100-V applied voltage.

   a. Average greater than 1 megohm and less than or equal to 1000 megohms when test specimens are tested surface to ground.
   b. Average greater than 1 megohm and less than or equal to 1000 megohms when installed floor coverings are tested surface to ground.

2. Static Generation: Less than 300 V when tested per AATCC-134 at 20 percent relative humidity with conductive footwear.
3. Static Decay: 5000 to zero V in less than 0.25 seconds when tested per FED-STD-101C/4046.1.

B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 STATIC-DISSIPATIVE RESILIENT FLOOR COVERINGS

A. Static-Dissipative, Vinyl Composition Floor Tile (SDT): ASTM F 1066 (vinyl composition floor tile, nonasbestos formulated), Class 2 (through-pattern tile).

1. Basis-of-Design Product: Subject to compliance with requirements provide the following:

a. Armstrong World Industries, Inc.; Static Dissipative SDT.

2. Thickness: Not less than 0.125 inch (3.2 mm).
3. Size: 12 by 12 inches (305 by 305 mm).
4. Colors and Patterns: As selected by Architect from full range of industry colors**.**

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified portland cement or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Static-Control Adhesive: Provided or approved by manufacturer; type that maintains electrical continuity of floor-covering system to ground connection.

C. Grounding Strips: Provided or approved by manufacturer; type and size that maintains electrical continuity of floor-covering system to ground connection.

D. Floor Polish: Provide protective, static-control liquid floor polish products as recommended by floor-covering manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion or static-control characteristics of floor coverings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of static-control resilient flooring and electrical continuity of floor-covering systems.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with floor-covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

    a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Perform relative-humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative-humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install static-control resilient flooring until it is same temperature as space where it is to be installed.

1. Move static-control resilient flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum substrates to be covered by static-control resilient flooring immediately before installation.

3.3 INSTALLATION, GENERAL

A. Install static-control resilient flooring according to manufacturer's written instructions.

B. Embed grounding strips in static-control adhesive. Extend grounding strips beyond perimeter of static-control resilient floor-covering surfaces to ground connections.

C. Scribe, cut, and fit static-control resilient flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

D. Extend static-control resilient flooring into toe spaces, door reveals, closets, and similar openings. Extend static-control resilient flooring to center of door openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on static-control resilient flooring as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

F. Install static-control resilient flooring on covers for telephone and electrical ducts, and similar items in installation areas. Maintain overall continuity of color and pattern with pieces of static-control resilient flooring installed on covers. Tightly adhere static-control resilient flooring edges to substrates that abut covers and to cover perimeters.

G. Adhere static-control resilient flooring to substrates using a full spread of static-control adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 FLOOR-TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half floor tile at perimeter.

1. Lay floor tiles square with room axis.

C. Match floor tiles for color and pattern by selecting floor tiles from cartons in same sequence as manufactured and packaged if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.

1. Lay static-dissipative, vinyl composition floor tiles with grain running in one direction.

3.5 FIELD QUALITY CONTROL

A. Testing: Engage a qualified testing agency to test electrical resistance of static-control resilient flooring for compliance with requirements.

1. Arrange for testing after static-control adhesives have fully cured and static-control resilient flooring has stabilized to ambient conditions and after ground connections are completed.
2. Arrange for testing of static-control resilient flooring before and after performing floor polish procedures.

B. Static-control resilient flooring will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of static-control resilient flooring.

B. Perform the following operations immediately after completing static-control resilient flooring:

1. Remove static-control adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect static-control resilient flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

1. If recommended in writing by manufacturer, apply protective static-control floor polish formulated to maintain or enhance floor covering's electrical properties; ensure static-control resilient flooring surfaces are free from soil, static-control adhesive, and surface blemishes.

a. Verify that both floor polish and its application method are approved by manufacturer and that floor polish will not leave an insulating film that reduces static-control resilient flooring's effectiveness for static control.

D. Cover static-control resilient flooring until Substantial Completion.

END OF SECTION 096536

SECTION 096566 - RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Rubber floor tile.

B. Related Sections:

   1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4
      a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

   2. Section 096513 "Resilient Base and Accessories" for wall base and accessories installed with flooring.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Show installation details and locations of the following:
   1. Layout, colors, widths, and dimensions.
   2. Locations of floor inserts for athletic equipment installed through flooring, outlets, built-in furniture, cabinets and cutouts.

D. Samples for Verification: For each type, color, and pattern of flooring indicated, 6-inch- (150-mm-) square Samples of same thickness and material indicated for the Work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified sheet vinyl flooring Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Resilient Athletic Flooring to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish no fewer than 1 box for each 50 boxes or fraction thereof, of each type, color, pattern, and size of floor tile installed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced Installer who has completed resilient athletic flooring installations using methods indicated for this Project and similar in material, design, and extent to that indicated for this Project; who is acceptable to manufacturer; and whose work has resulted in installations with a record of successful in-service performance.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.

B. Store materials to prevent deterioration. Store tiles on flat surfaces..

1.9 FIELD CONDITIONS

A. Adhesively Applied Products:

1. Maintain temperatures during installation within range recommended in writing by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive flooring 48 hours before installation, during installation, and 48 hours after installation unless longer period is recommended in writing by manufacturer.
2. After postinstallation period, maintain temperatures within range recommended in writing by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
3. Close spaces to traffic during flooring installation.
4. Close spaces to traffic for 48 hours after flooring installation unless manufacturer recommends longer period in writing.

B. Install flooring after other finishing operations, including painting, have been completed.

1.10 COORDINATION

1. Coordinate layout and installation of flooring with floor inserts for equipment, , outlets, built-in furniture, cabinets and cutouts.

PART 2 - PRODUCTS

2.1 RUBBER FLOOR TILE (RES-1)

A. Basis-of-Design Product: Subject to compliance with requirements, provide Recoil Fitness Flooring; Roppe Corporation.

B. Description: Athletic flooring consisting of modular rubber tiles with smooth edges for adhered application.

C. Material: Recycled-rubber compound encapsulated in urethane binder..

D. Traffic-Surface Texture: Smooth,Nondirectional, stipple texture.

E. Size: 36 inches (914 mm) square.

F. Thickness: 3/8 inch (9.5 mm).

G. Weight: Not less than 20 lbs. per tile.

H. Color and Pattern: Equal to Light Gray No. 195; Roppe Corporation.

2.2 ACCESSORIES

A. Trowelable Leveling and Patching Compound: Latex-modified, hydraulic-cement-based formulation approved by flooring manufacturer.

B. Adhesives: Water-resistant type recommended in writing by manufacturer for substrate and conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of flooring.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Alkalinity Testing: Perform pH testing according to ASTM F 710. Proceed with installation only if pH readings are not less than 7.0 and not greater than 8.5.
3. Moisture Testing:

a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.

1) Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) , and perform no fewer than two tests in each installation area and with test areas evenly spaced in installation areas.

C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by manufacturer. Do not use solvents.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

E. Move flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation unless manufacturer recommends a longer period in writing.

1. Do not install flooring until they are same temperature as space where they are to be installed.

F. Sweep and vacuum clean substrates to be covered by flooring immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust.

G. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 FLOORING INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions.

B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

3.4 FLOOR TILE INSTALLATION

A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

   1. Lay tiles square with room axis.

B. Discard broken, cracked, chipped, or deformed tiles.

C. Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged if so numbered.

   1. Lay tiles with grain running in one direction.

D. Adhered Flooring: Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

   1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.5 CLEANING AND PROTECTING

A. Perform the following operations immediately after completing flooring installation:

   1. Remove adhesive and other blemishes from flooring surfaces.
   2. Sweep and vacuum flooring thoroughly.
   3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.

B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

   1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096566

SECTION 096613 - PORTLAND CEMENT TERRAZZO FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Precast terrazzo units for stair treads, risers and landings.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Division 07 Section "Joint Sealants" for sealants installed with terrazzo.
3. Division 09 Section “Resinous Matrix Terrazzo Flooring” for epoxy resin terrazzo.

1.3 DEFINITIONS

A. Aggregate: Marble chips.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

C. Shop Drawings: Include terrazzo installation requirements. Include plans, elevations, sections, component details, and attachments to other work. Show layout of the following:

1. Stair treads, risers, and landings.
2. Precast terrazzo jointing and edge configurations.

D. Samples for Initial Selection: NTMA color plates showing the full range of colors and patterns available for each terrazzo type.

E. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in size indicated below:

1. Precast Terrazzo: 6-inch (150-mm) square Samples.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Portland Cement Terrazzo Flooring to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An installer who is experienced in the types of installations required for this project, with a record of successful performance.

B. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of three stair treads and one landing.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with sources or manufacturer's name, material or product brand name, and lot number if any.

B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Maintain temperature above 50 deg F (10 deg C) for 48 hours before and during terrazzo installation.

B. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.

2.2 PRECAST TERRAZZO

A. Precast Terrazzo Units: Thickness as indicated, or if not indicated minimum 3/4-inch (19-mm) thick, reinforced, portland cement terrazzo units. Comply with NTMA's written recommendations for fabricating precast terrazzo units in sizes and profiles indicated. Reinforce units as required by unit sizes, profiles, and thicknesses and as recommended by manufacturer. Finish exposed-to-view edges and reveals to match face finish. Ease exposed edges to 1/8-inch (3.2-mm) radius. Provide the following:

1. Stair risers, treads and landings.

2.3 MISCELLANEOUS ACCESSORIES

A. Anchoring Devices:

1. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.

B. Portland Cement Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by cleaner manufacturer for use on terrazzo type indicated.

C. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; is recommended by sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.

1. Surface Friction: Not less than 0.6 according to ASTM D 2047.
2. Acid-Base Properties: With pH factor between 7 and 10.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

3.2 PREPARATION

A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.

3.3 INSTALLATION, GENERAL

A. Comply with NTMA's written recommendations for terrazzo and accessory installation.

B. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet (6.4 mm in 3 m); noncumulative.

3.4 PRECAST TERRAZZO INSTALLATION

A. Install precast terrazzo units using method recommended by NTMA and manufacturer unless otherwise indicated.

B. Do not install units that are chipped, cracked, discolored, or improperly finished.

3.5 CLEANING AND PROTECTION

A. Terrazzo Cleaning:

1. Wash surfaces with cleaner immediately after final cleaning of terrazzo flooring according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.

B. Sealing:

1. Seal surfaces according to NTMA's written recommendations.
2. Apply sealer according to sealer manufacturer's written instructions.

C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION 096613

SECTION 096623 - RESINOUS MATRIX TERRAZZO FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Thin-set, epoxy-resin terrazzo flooring and base.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.
2. Section 079200 "Joint Sealants" for sealants installed with terrazzo.

1.3 DEFINITIONS

A. Aggregate: Marble chips or other types of aggregate.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to terrazzo including, but not limited to, the following:

   a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
   b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   c. Review special terrazzo designs and patterns.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

C. Shop Drawings: Include terrazzo installation requirements. Include plans, elevations, sections, component details, and attachments to other work. Show layout of the following:

1. Divider strips.
2. Control-joint strips.
3. Accessory strips.
4. Terrazzo patterns.

D. Samples for Initial Selection: NTMA color plates showing the full range of colors and patterns available for each terrazzo type.

E. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in size indicated below:

1. Terrazzo: 6-inch- (150-mm-) square Samples.
2. Accessories: 6-inch- (150-mm-) long Samples of each exposed strip item required.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Certificates: For each type of terrazzo material or product, from manufacturer.

C. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Resinous Matrix Terrazzo Flooring to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Engage an installer who is a contractor member of NTMA.
2. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products.

B. Source Limitations: Obtain primary terrazzo materials from single source from single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.

C. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.

D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups for terrazzo including accessories.

a. Size: Minimum 100 sq. ft. (9 sq. m) of typical poured-in-place flooring and base condition for each color and pattern in locations directed by Architect.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.

B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.

B. Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.

C. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period.

D. Control and collect water and dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.

2.2 EPOXY-RESIN TERRAZZO

A. Epoxy-Resin Terrazzo (TERR): Comply with NTMA's "Terrazzo Specifications and Design Guide" and manufacturer's written instructions for matrix and aggregate proportions and mixing.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Crossfield Products Corp., Dex-O-Tex Division; CheminertTerrazzo.
b. TEC Specialty Construction Brands, Inc.; Tuff-Lite Epoxy Terrazzo.
c. Terrazzo & Marble Supply Companies; Terroxy Resin Systems.

2. Thickness: 1/4 inch (6.4 mm) nominal.
3. Custom Mix Color and Pattern: Equal to 09-971; Terrazzo & Marble Supply Companies..

B. Materials:

1. Flexible Reinforcing Membrane: Manufacturer's resinous membrane for substrate-crack preparation and reflective-crack reduction.

a. Reinforcement: Fiberglass scrim.

2. Primer: Manufacturer's product recommended for substrate and use indicated.
3. Epoxy-Resin Matrix: Manufacturer's standard recommended for use indicated and in color required for mix indicated.

a. Physical Properties without Aggregates:

1) Hardness: 60 to 85 per ASTM D 2240, Shore D.
2) Minimum Tensile Strength: 3000 psi (20.7 MPa) per ASTM D 638 for a 2-inch (51-mm) specimen made using a "C" die per ASTM D 412.
3) Minimum Compressive Strength: 10,000 psi (6.9 MPa) per ASTM D 695, Specimen B cylinder.
4) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.

a) Distilled water.
b) Mineral water.
c) Isopropanol.
d) Ethanol.
e) 0.025 percent detergent solution.

f) 1.0 percent soap solution.
g) 10 percent sodium hydroxide.
h) 10 percent hydrochloric acid.
i) 30 percent sulfuric acid.
j) 5 percent acetic acid.

b. Physical Properties with Aggregates: For resin blended with Georgia white marble, ground, grouted, and cured per requirements in NTMA's "Terrazzo Specifications and Design Guide"; comply with the following:

1) Flammability: Self-extinguishing, maximum extent of burning 1/4 inch (6.35 mm) per ASTM D 635.
2) Thermal Coefficient of Linear Expansion: 0.0025 inch/inch per deg F (0.0025 mm/mm per 0.5556 deg C) for temperature range of minus 12 to plus 140 deg F (minus 24 to plus 60 deg C) per ASTM D 696.

4. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.

a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131.
b. 24-Hour Absorption Rate: Less than 0.75 percent.
c. Dust Content: Less than 1.0 percent by weight.

5. Finishing Grout: Resin based.

2.3 STRIP MATERIALS

A. Thin-Set Divider Strips: L-type angle, 1/4 inch (6.4 mm) deep.

1. Material: Aluminum.
2. Top Width: 1/8 inch (3.2 mm).

B. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.

C. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:

1. Base-bead strips for exposed top edge of terrazzo base.
2. Edge-bead strips for exposed edges of terrazzo.

2.4 MISCELLANEOUS ACCESSORIES

A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use.

B. Anchoring Devices:

1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and required for secure attachment to substrate.

C. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.

D. Joint Compound: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.

E. Resinous Matrix Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.

F. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; is recommended by sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.

1. Surface Friction: Not less than 0.6 according to ASTM D 2047.
2. Acid-Base Properties: With pH factor between 7 and 10.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

3.2 PREPARATION

A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.

B. Concrete Slabs:

1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.

a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written recommendations.
c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.

C. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

1. Moisture Testing: Perform tests indicated below.

    a. Calcium Chloride Test: Perform anhydrous calcium chloride test per ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.

        1) Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m) , and perform not less than two tests in each installation area and with test areas evenly spaced in installation areas.

D. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.

    1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

3.3 EPOXY-RESIN TERRAZZO INSTALLATION

A. Comply with NTMA's written recommendations for terrazzo and accessory installation.

B. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions and NTMA's "Terrazzo Specifications and Design Guide."

C. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet (6.4 mm in 3 m); noncumulative.

D. Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.

E. Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.

F. Flexible Reinforcing Membrane:

    1. Prepare and prefill substrate cracks with membrane material.
    2. Install membrane to produce full substrate coverage in areas to receive terrazzo.
    3. Reinforce membrane with fiberglass scrim.
    4. Prepare membrane according to manufacturer's written instructions before applying substrate primer.

G. Primer: Apply to terrazzo substrates according to manufacturer's written instructions.

H. Strip Materials:

    1. Divider and Control-Joint Strips:

        a. Locate divider strips in locations indicated.
        b. Install control-joint strips back to back directly above concrete-slab control joints.

c. Install control-joint strips with 1/4-inch (6.4-mm) gap between strips, and install sealant in gap.
d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.

2. Accessory Strips: Install as required to provide a complete installation.

3.4 REPAIR

A. Cut out and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

3.5 CLEANING AND PROTECTION

A. Cleaning:

1. Remove grinding dust from installation and adjacent areas.
2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.

B. Sealing:

1. Seal surfaces according to NTMA's written recommendations.
2. Apply sealer according to sealer manufacturer's written instructions.

C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION 096623

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes modular, tufted carpet tile.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4 and 16a-38k-4(b)6
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:

   a. Review delivery, storage, and handling procedures.
   b. Review ambient conditions and ventilation procedures.
   c. Review subfloor preparation procedures.
   d. Review wall transitions.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include installation recommendations for each type of substrate.

C. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

D. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Tile Carpeting to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

B. Warranty: For Tile Carpeting specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.8 QUALITY ASSURANCE SUBMITTALS

A. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups at locations and in sizes shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

1.11 FIELD CONDITIONS

A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.12 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber, and delamination.
3. Warranty Period: Lifetime from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE (CPT-1 and CPT-2)

A. Basis-of-Design Product: Subject to compliance with requirements, provide Modular; Mohawk Group, Lees.

B. Color:
1. CPT-1 Basis-of-Design: Hem, Jean, Selvedge 966
2. CPT-2: Basis-of-Design Hem, Jean, Seledge 937.

C. Name/Collection: Denim.

D. Product Type: Modular.

E. Construction: Tufted.

F. Surface Texture: Textured patterned loop.

G. Fiber Content: 100 percent nylon.

H. Density: 5942

I. Pile Thickness: .103”

J. Stitches: 11 per inch.

K. Gauge: 1/12.

L. Surface Pile Weight: 17 oz./sq. yd. (g/sq. m).

M. Primary Backing/Backcoating: Vinyl modular, equal to EcoFlex, Mohawk Group, Lees.

N. Size: 24 by 24 inches (610 by 610 mm).

O. Applied Soil-Resistance Treatment: Manufacturer's standard material.

P. Performance Characteristics: As follows:

1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D 7330.
2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.
3. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D 2646.
4. Tuft Bind: Not less than 5 lbf (22 N) according to ASTM D 1335.
5. Delamination: Not less than 3.5 lbf/in. (15 N/mm) according to ASTM D 3936.
6. Dimensional Tolerance: Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.
7. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
8. Resistance to Insects: Comply with AATCC 24.
9. Noise Reduction Coefficient (NRC): according to ASTM C 423.
10. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
11. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) according to AATCC 16, Option E.
12. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.
13. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
2. Subfloor finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer to acheive specified warranty

C. Maintain dye lot integrity. Do not mix dye lots in same area.

D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern parallel to walls and borders.

H. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 096900 - ACCESS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Access-flooring panels.
2. Understructure.
3. Floor panel coverings.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 260526 "Grounding and Bonding for Electrical Systems" for connection to ground of access-flooring understructure.

1.3 COORDINATION

A. Coordinate location of mechanical and electrical work in underfloor cavity to prevent interference with access-flooring pedestals.

B. Mark pedestal locations on subfloor using a grid to enable mechanical and electrical work to proceed without interfering with access-flooring pedestals.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review connection with mechanical and electrical systems.
2. Review procedures for keeping underfloor space clean.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

C. Shop Drawings: Include layout of access-flooring system and relationship to adjoining Work based on field-verified dimensions.

1. Details and sections with descriptive notes indicating materials, finishes, fasteners, typical and special edge conditions, accessories, and understructures.

D. Samples:

1. Floor Covering: Full-size units for each color and texture specified.
2. Exposed Metal Accessories: Approximately 10 inches (250 mm) in length.
3. One complete full-size floor panel, pedestal, and understructure unit for each type of access-flooring system required.

E. Samples for Initial Selection: For each type of product and exposed finish.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of access-flooring system.

C. Product Test Reports: For each type of flooring material and exposed finish, for tests performed by a qualified testing agency.

D. Preconstruction Test Reports: For preconstruction adhesive field test.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Flooring Panels: 5.
2. Pedestals: 5.
3. Stringers: 5.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install access flooring until spaces are enclosed, ambient temperature is between 50 and 90 deg F (10 and 32 deg C), and relative humidity is not less than 20 and not more than 70 percent.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Access flooring shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Structural Performance: Provide access-flooring systems capable of complying with the following performance requirements according to testing procedures in CISCA's "Recommended Test Procedures for Access Floors":

1. Concentrated Loads: 1000 lbf (4448 N) with the following deflection and permanent set:

   a. Top-Surface Deflection: 0.10 inch (2.54 mm).
   b. Permanent Set: 0.010 inch (0.25 mm).

2. Ultimate Loads: 2000 lbf (8896 N).
3. Rolling Loads: With local or overall deformation not to exceed 0.040 inch (1.02 mm).

   a. CISCA Wheel 1: 10 passes at 800 lbf (3559 N).
   b. CISCA Wheel 2: 10,000 passes at 600 lbf (2669 N).

4. Stringer Load Test: 450 lbf (2002 N) at center of span with a permanent set not to exceed 0.010 inch (0.25 mm).
5. Pedestal Axial Load Test: [6000 lbf (26 690 N).
6. Pedestal Overturning Moment Test: 1000 lbf x inches (113 N x meters).
7. Drop Impact Load Test: 150 lb (68.0 kg).

C. Fire Performance:

1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.

2. Combustion Characteristics: ASTM E 136.

2.2 MANUFACTURERS

A. Source Limitations: Obtain access-flooring system from single source from single manufacturer.

2.3 FLOOR PANELS

A. Floor Panels, General: Provide modular panels interchangeable with other field panels without disturbing adjacent panels or understructure.

1. Size: Nominal 24 by 24 inches (610 by 610 mm).
2. Attachment to Understructure: Bolted.

B. Cementitious-Core Steel Panels: Fabricated from cold-rolled steel sheet, with the die-cut flat top sheet and die-formed and stiffened bottom pan welded together, and with metal surfaces protected against corrosion by manufacturer's standard factory-applied finish. Fully grout internal spaces of completed units with manufacturer's standard cementitious fill.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ASM Modular Systems, Inc.
b. Haworth, Inc.
c. Tate Access Floors, Inc.

2.4 UNDERSTRUCTURE

A. Pedestals: Assembly consisting of base, column with provisions for height adjustment, and head (cap); made of steel.

1. Provide pedestals designed for use in seismic applications.
2. Base: Square or circular base with not less than 16 sq. in. (103 sq. cm) of bearing area.
3. Column: Of height required to bring finished floor to elevations indicated. Weld to base plate.
4. Provide vibration-proof leveling mechanism for making and holding fine adjustments in height over a range of not less than 1 inches (25.4 mm) and for locking at a selected height, so deliberate action is required to change height setting and prevent vibratory displacement.
5. Head: Designed to support the panel system indicated.

a. Provide sound-deadening pads or gaskets at contact points between heads and panels.

B. Stringer Systems: Modular steel stringer systems designed to bolt to pedestal heads and form a grid pattern. Protect steel components with manufacturer's standard galvanized or corrosion-resistant paint finish.

1. Continuous Gaskets: At contact surfaces between panel and stringers to deaden sound, seal off the underfloor cavity from above, and maintain panel alignment and position.

2.5 FLOOR PANEL COVERINGS

A. Static-Dissipative Vinyl Tile: Factory applied, ASTM F 1700, Class I (Monolithic Vinyl Tile), Type A (Smooth Surface), fabricated in one piece to cover panel face with monolithic edging.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Flexco, Inc.
   b. Forbo Industries, Inc.
   c. VPI Corporation.

2. Electrical Resistance: Average no less than 1 megohm and no more than 1000 megohms when installed floor coverings are surface-to-ground tested according to ASTM F 150 with 100-V applied voltage.
3. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range.

2.6 FABRICATION

A. Fabrication Tolerances:

1. Size: Plus or minus 0.020 inch (0.50 mm) of required size.
2. Squareness: Plus or minus 0.015 inch (0.38 mm) between diagonal measurements across top of panel.
3. Flatness: Plus or minus 0.035 inch (0.89 mm), measured on a diagonal on top of panel.

B. Panel Markings: Clearly and permanently mark floor panels on their underside with panel type and concentrated-load rating.

C. Bolted Panels: Provide panels with holes drilled in corners to align precisely with threaded holes in pedestal heads and to accept countersunk screws with heads flush with top of panel.

1. Captive Fasteners: Provide fasteners held captive to panels.

D. Cutouts: Fabricate cutouts in floor panels for cable penetrations and service outlets. Provide reinforcement or additional support, if needed, to make panels with cutouts comply with structural performance requirements.

1. Number, Size, Shape, and Location: As indicated.
2. Grommets: Where indicated, fit cutouts with manufacturer's standard grommets; or, if size of cutouts exceeds maximum grommet size available, trim edge of cutouts with manufacturer's standard plastic molding with tapered top flange. Furnish removable covers for grommets.
3. Provide foam-rubber pads for sealing annular space formed in cutouts by cables.

2.7 ACCESSORIES

A. Post-Installed Anchors: For anchoring pedestal bases to subfloor, provide a min. of two post-installed expansion anchors or threaded concrete screws made from carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (5 microns) for Class SC 1 (Mild), with the capability to sustain, without failure, a load equal to 1.5 times the loads imposed by pedestal overturning moment on fasteners, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

B. Floor Grilles: Standard load-bearing grilles formed from aluminum to produce removable one-piece unit precisely fitted in factory-prepared openings of standard field panels, without dampers and complying with the following requirements:

1. Air-Distribution Characteristics: Min. of 468 cfm at 0.10-inch wg (221 L/s at 25-Pa) static pressure.
2. Structural Performance: Capable of supporting a 1000-lbf (4448-N) concentrated load.
3. Fire-Test-Response Characteristics: Classified 94V-0 according to UL 94.

C. Closures: Where underfloor cavity is not enclosed by abutting walls or other construction, provide metal-closure plates with manufacturer's standard finish.

D. Ramps: Manufacturer's standard ramp construction of width and slope indicated, but not steeper than 1:12, with raised-disc or textured rubber or vinyl-tile floor coverings, and of same materials, performance, and construction requirements as access flooring.

E. Railings: Standard extruded-aluminum railings at ramps and open-sided perimeter of access flooring where indicated. Include handrail, intermediate rails, posts, brackets, end caps, wall returns, wall and floor flanges, plates, and anchorages where required.

1. Provide railings that comply with structural performance requirements specified in Section 055213 "Pipe and Tube Railings."

F. Perimeter Support: Where indicated, provide manufacturer's standard method for supporting panel edge and forming transition between access flooring and adjoining floor coverings at same level as access flooring.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer and manufacturer's representative present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, foreign deposits, and debris that might interfere with attachment of pedestals.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Lay out floor panel installation to keep the number of cut panels at floor perimeter to a minimum. Avoid using panels cut to less than 6 inches (152 mm).

B. Locate each pedestal, complete any necessary subfloor preparation, and vacuum subfloor to remove dust, dirt, and construction debris before beginning installation.

3.3 INSTALLATION

A. Install access-flooring system and accessories under supervision of access-flooring manufacturer's authorized representative to produce a rigid, firm installation that complies with performance requirements and is free of instability, rocking, rattles, and squeaks.

B. Mechanical Attachment of Pedestals: Attach pedestals to subfloor with post-installed mechanical anchors.

C. Adjust pedestals to permit top of installed panels to be set flat, level, and to proper height.

D. Stringer Systems: Secure stringers to pedestal heads according to access-flooring manufacturer's written instructions.

E. Install flooring panels securely in place, properly seated with panel edges flush. Do not force panels into place.

F. Scribe perimeter panels to provide a close fit with adjoining construction with no voids greater than 1/8 inch (3 mm) where panels abut vertical surfaces.

1. To prevent dusting, seal cut edges of steel-encapsulated, wood-core panels with sealer recommended in writing by panel manufacturer.

G. Cut and trim access flooring and perform other dirt-or-debris-producing activities at a remote location or as required to prevent contamination of subfloor under already-installed access flooring.

H. Grounded Flooring Access Panel Systems: Ground flooring system as recommended by manufacturer and as needed to comply with performance requirements for electrical resistance of floor coverings.

1. Panel-to-Understructure Resistance: Not more than 10 ohms as measured without floor coverings.

I. Closures: Scribe closures to closely fit against subfloor and adjacent finished-floor surfaces. Set in mastic and seal to maintain plenum effect within underfloor cavity.

J. Clean dust, dirt, and construction debris caused by floor installation, and vacuum subfloor area as installation of floor panels proceeds.

K. Install access flooring without change in elevation between adjacent panels and within the following tolerances:
   1. Plus or minus 1/8 inch (3 mm) from a level plane over entire access-flooring area.

3.4 PROTECTION

A. Prohibit traffic on access flooring for 24 hours and removal of floor panels for 72 hours after installation to allow pedestal adhesive to set.

B. After completing installation, vacuum access flooring and cover with continuous sheets of reinforced paper or plastic. Maintain protective covering until time of Substantial Completion.

C. Replace access-flooring panels that are stained, scratched, or otherwise damaged or that do not comply with specified requirements.

END OF SECTION 096900

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on interior substrates.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)5
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
3. Section 099600 "High-Performance Coatings" for high-performance and special-use coatings.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product. Include preparation requirements and application instructions.

C. Samples for Initial Selection: For each type of topcoat product.

D. Samples for Verification: For various types of paint system and in each color and gloss of topcoat, if requested.

1. Submit Samples on specified substrate (s).
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

E. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. VOC content.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups (If requested): Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

B. Applicator Qualifications: Engage an experienced applicator who has successfully completed painting applications similar to those required for this project.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C) an in accordance with manufacturers specifications and recommendations.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

B. Deliver all materials to the job site in unopened, original containers, bearing manufacturer's label. Labels shall include the following information:

1. Name of manufacturer.
2. Name of material.
3. Contents by volume of major pigment and vehicle constituents.
4. Thinning instructions (If any).
5. Application instructions, including recommended rate of application.
6. VOC content.
7. Color name and number.

C. Deliver paint to the job site in quantities sufficiently large enough so that several different batches of the same color will not be required.

1.7 DISPOSAL OF MATERIALS:

A. Do not use plumbing fixtures or waste pipes for disposal of any waste oil, paint, solvents or any other materials. Dispose of all waste materials off site in a legal manner.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore & Co.
2. PPG Architectural Finishes, Inc.
3. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. Colors: As selected by Architect from manufacturer's full range.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (CMU): 12 percent.
3. Wood: 15 percent.
4. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer**.**

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

J. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in occupied spaces:
   a. Uninsulated metal piping.
   b. Uninsulated plastic piping.
   c. Pipe hangers and supports.
   d. Metal conduit.
   e. Plastic conduit.
   f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   g. Other items as directed by Architect.

2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Ferrous Metal:

1. First Coat: (Alkyd) (Omit if shop primed).

    a. Sherwin Williams - Kem Bond HS Universal Metal Primer B50 Series
    b. Benjamin Moore – Alkyd Metal Primer M06.
    c. PPG – Speedhide Rust-Inhibitive Primer 6-208, 6-212 Series.

2. Second and Third Coats: (Semigloss Acrylic)

    a. Sherwin Williams – Pro ClassicWaterborne Acrylic Semi-Gloss B31.
    b. Benjamin Moore – Moorcraft 100% Acrylic Semi-Gloss Enamel 281.
    c. PPG - Manor Hall Acrylic 87-Line.

B. Galvanized Metal:

1. First Coat: (Acrylic) (Omit if shop primed)

    a. Sherwin Williams – DTM Acrylic Primer Finish B66W1.
    b. Benjamin Moore – Acrylic Metal Primer M04.
    c. PPG – Pitt-Tech Industrial Primer 90-708 or 90-712.

2. Second and Third Coats (Semigloss Acrylic)

a. Sherwin Williams – Pro Classic Waterborne Acrylic Semi-Gloss B31.
b. Benjamin Moore – Moorcraft 100% Acrylic Semi-Gloss Enamel 281.
c. PPG – Manor Hall Acrylic 87-Line.

C. Overhead Exposed Steel Structure and Deck (Acrylic Dry Fall).

1. First Coat: (Omit if shop primed or galvanized).

a. Sherwin Williams – DTM Acrylic Primer/Finish B66W1.
b. Benjamin Moore – Acrylic Metal Primer M04.
c. PPG – DTM Primer/Finish 90-712.

2. Second and Third Coats (Acrylic Dry Fall).

a. Sherwin Williams – Waterborne Acrylic Dry Fall Eg-Shel B42W2.
b. Benjamin Moore – Sweep Up Latex Dry Fall Eg-Shel M535.
c. PPG – Latex Dry Fog Spray Paint 6-714.

D. Gypsum Wallboard: (Semigloss)

1. First Coat: (Latex Primer)

a. Sherwin Williams – ProMar 200 Zero VOC Int. Latex Primer B28W2600.
b. Benjamin Moore – Pristine Eco Spec Latex Primer Sealer 231.
c. PPG – Speedhide Low Odor Latex Sealer UC 80020.

2. Second and Third Coats: (Acrylic Semigloss)

a. Sherwin Williams – ProMar 200 Zero VOC Int. Latex Semi-Gloss B20 26 Series.
b. Benjamin Moore – Pristine Eco Spec Interior Latex Semi-Gloss Enamel 224.
c. PPG – Speedhide Low Odor Semi-Gloss UC 80023.

3. Where Required: Ceilings and walls in damp areas, such as Toilet Rooms, Janitor Closets and Utility Rooms. Not shower rooms – use epoxy wall coating (EWC) in shower rooms.

E. Gypsum Wallboard (Eggshell):

1. First Coat: (Latex Primer)

a. Sherwin Williams – ProMar 200 Zero VOC Int. Latex Eggshell B20-2600 series.
b. Benjamin Moore – Pristine Eco Spec Interior Latex Primer Sealer 231.

PPG – Speedhide Low Odor Latex Sealer UC 80020.

2. Second and Third Coats: (Eggshell)

    a. Sherwin Williams – ProMar 200 Zero VOC Int. Latex Eggshell B20-2600 series.
    b. Benjamin Moore - Pristine Eco Spec Interior Latex Eggshell Enamel 223.
    c. PPG – Speedhide Low Odor Eggshell UC 80022.

3. Where Required:

    a. Walls in dry areas not indicated to receive another finish (i.e. ceramic tile, wall covering, etc.).

F. Gypsum Wallboard: (Flat)

1. First Coat: (Latex Primer)

    a. Sherwin Williams – ProMar 200 Zero VOC Int. Latex Primer B28W2600.
    b. Benjamin Moore – Pristine Eco Spec Interior Latex Primer Sealer 231.
    c. PPG – Speedhide Low Odor Latex Sealer UC 80020.

2. Second and Third Coats: (Latex Flat)

    a. Sherwin Williams – ProMar 200 Zero VOC Int. Latex Flat B30-2600 series.
    b. Benjamin Moore – Pristine Eco Spec Interior Latex flat 219.
    c. PPG – Speedhide Low Odor Flat UC 80021.

3. Where Required: Ceilings not indicated to receive another finish.

G. Concrete Masonry Units:

1. First Coat: (Latex Block Filler)

    a. Sherwin-Williams – Loxon Block Surfacer A24W200.
    b. Benjamin Moore – Moorcraft Super Craft Latex Block Filler 285.
    c. PPG – Speedhide Latex Block Filler 6-7.

2. Second and Third Coats: (Latex EggShell)

    a. Sherwin-Williams – ProMar 200 Zero VOC Int. Latex Eggshell B20-2600 series.
    b. Benjamin Moore – Pristine Eco Spec Interior Latex Eggshell Enamel 223.
    c. PPG – Speedhide Low Odor Eggshell UC 80022.

H. Concrete:

1. First Coat:

    a. Sherwin-Williams – Loxon Concrete and Masonry Primer B24W8300.
    b. Benjamin Moore – Moore's Acrylic Masonry Sealer 066.
    c. PPG – Speedhide Acrylic Alkali Resistant Primer 6-603.

2. Second and Third Coats: (Latex EggShell)

    a. Sherwin-Williams – ProMar 200 Zero VOC Int. Latex Eggshell B20-2600 series.
    b. Benjamin Moore – Pristine Eco Spec Interior Latex Eggshell Enamel 223.
    c. PPG: Speedhide Low Odor Eggshell UC 80022.

I. Wood-Painted Finish:

1. First Coat: (Latex)

    a. Sherwin Williams – Premium Interior Wall and Wood Primer B28W8111.
    b. Benjamin Moore – Alkyd Primer M06.
    c. PPG – Speedhide Quick Dry Undercoater 6-6.

2. Second and Third Coats: (Acrylic Semigloss)

    a. Sherwin Williams – Pro Classic Waterborne Acrylic Semi-Gloss B31.
    b. Benjamin Moore – Moorcraft 100% Acrylic Semi-Gloss Enamel 281.
    c. PPG – Manor Hall Acrylic 87-Line.

J. Wood-Stain and Varnish Finish:

1. First Coat: (Filler – for open grain wood only).

    a. Sherwin Williams – Sher-Wood Natural Filler D70T1.
    b. Benjamin Moore – Paste Filler, Natural 238.
    c. PPG – Paste Wood Filler.

2. Second Coat: (Alkyd Stain)

    a. Sherwin Williams – Wood Classics Interior Oil Stain A49 Series.
    b. Benjamin Moore – Benwood IWF Penetrating Stain 234.
    c. PPG – Interior Semi-Transparent Stain #77-560.

3. Third and Fourth Coats: (Alkyd Satin)

    a. Sherwin Williams – Wood Classics Waterbourne Polyurethane Varnish A68 Series. (Satin A68F90 or Gloss A68V91)
    b. Benjamin Moore – Benwood Polyurethane Finish Low Lustre C435.
    c. PPG – Rez Polyurethane Varnish 77-89.

K. Wood-Clear Varnish Finish: Two coats over prepared surface.

1. First and Second Coats: (Alkyd Satin).

    a. Sherwin Williams – Wood Classics Waterbourne Polyurethane Varnish A68 Series. (Satin A68F90 or Gloss A68V91)
    b. Benjamin Moore - Benwood Polyurethane Finish Low Lustre C435.
    c. PPG – Rez Polyurethane Varnish 77-89.

L. Pipe Covering:

1. First and Second Coats: (Latex Flat)

    a. Sherwin Williams - ProMar 200 Zero VOC Int. Latex Flat B30-2600 series.
    b. Benjamin Moore – Moorcraft SuperSpec Latex Flat 275.
    c. PPG – Speedhide Interior Flat Latex 6-70 Series.

M. Traffic Marking Paint (Concrete Floors):

1. First Coat: (Alkyd or Acrylic)

    a. Sherwin Williams – Pro-Park Traffic Marking Paint B97WD2434.
    b. Benjamin Moore – Safety & Zone Marking Paint M56 or M58.
    c. PPG – Traffic and Zone Marking Paint 11-3 or 11-10 Series.

2. Paint Stripe Width: 4 inches.
3. Paint Stripe Angle: 45 degrees.
4. Paint Stripe Spacing: 2’-0” clear between stripes.

END OF SECTION 099123

SECTION 099600 – HIGH PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and application of high-performance coating systems on the following substrates:

1. Exterior and Interior Substrates:
   a. Steel.
2. Interior Substrates:
   a. Concrete masonry units (CMU).

B. Related sections include the following:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4 and 16a-38k-4(b)5
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
3. Section 099123 "Interior Painting" for special-use coatings and general field painting.

1.2 DEFINITIONS:

A. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

B. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each coating system indicated.

1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference the specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.

C. Certification by manufacturer that products supplied comply with requirements indicated that limit the amount of VOCs in coating products.

D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.

E. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate.

1. Provide stepped Samples defining each separate coat including block fillers and primers.. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
2. List of material and application for each coat of each sample. Label each sample for location and application.
3. Submit samples on the following substrates for Architect's review of color and texture:

   a. Ferrous and Nonferrous Metal: Provide two 4-inch (100-mm) square samples of flat metal and two 8-inch (200-mm) long samples of solid metal for each color and finish.

F. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed high-performance coating system applications similar in material and extent to those indicated for Project and whose work has a record of successful in-service performance.

B. Source Limitations: Obtain primers and undercoat materials for each coating system from the same manufacturer as the finish coats.

C. Sample Areas

1. Apply sample areas of high performance coatings, approximately 50 sq.ft each, for each high performance coating type, where directed by the Architect, and receive approval prior to proceeding with remainder of work. Apply in stepped style showing each coat.
2. Approved areas will become standard of quality of work to follow.
3. Notify Architect when sample areas can be prepared and schedule time of application and examination with Architect.
4. Verify compatibility of primers, intermediate coats and topcoats with each other and with substrates prior to sample application. Verify that shop primers (if any) are as specified and/or appropriate for high performance coatings to be applied infield.

D. Workmanship shall be of the best quality. Apply all materials under adequate illumination, evenly spread and smoothly flowed on without runs or sags. Employ only skilled mechanics. Use materials only in accordance with the manufacturer’s labeled directions on the container, and/or manufacturer’s other written instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label with the following information:

1. Name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. Handling instructions and precautions.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45ºF (7ºC). Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect materials from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and applying coatings.

C. Deliver coatings to the job site in quantities sufficiently large enough so that several different batches of the same color will not be required.

1.6 PROJECT CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50ºF and 95ºF.

B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85%; at temperatures less than 5ºF (3ºC) above the dew point; or to damp or wet surfaces.

1. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before proceeding with or continuing coating operation.
2. Work may continue during inclement weather only if areas and surfaces to be coated are enclosed and temperature within the area can be maintained within limits specified by manufacturer during application and drying periods.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

PART 2 - PRODUCTS

2.1 HIGH-PERFORMANCE COATINGS, GENERAL:

A. Material Compatibility:
1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
3. Provide products of same manufacturer for each coat in a coating system.

2.2 BLOCK FILLERS:

A. Waterborne Cementitious Acrylic:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Tnemec Series 130 Envirofill.
2. VOC: 0.64 lbs/gallon.
3. Performance Criteria:
a. Adhesion: ASTM D 3359, Method B, 5 mm Crosshatch. Not less than a rating of 5.
b. Exterior Exposure: Exposed at 45 degrees facing south. Light industrial area. No blistering, cracking or loss of adhesion after three years exposure.
c. Freeze Thaw: ASTM D 2246. No blistering, cracking or loss of adhesion after 30 cycles.
d. Humidity: ASTM D 4585. No cracking, blistering or visable loss of film integrity after 1500 hours exposure.
e. Steam Pressure Test: Pressure Pot @ 250^0 F (121^0 C) and 15 to 17 psi (1.0 to 1.2 bars). No blistering or cracking after 4 hours continuous exposure.
f. Wind Driven Rain: TT-C-555B, 4.4.7.3. No cracking, blistering or visible damage to the substate or coating. No visible dampness on the backside of test specimen after 24 hours exposure.

2.3 METAL PRIMERS:

A. Primer, Zinc-Rich, Organic:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Tnemec Series H90-97 Tneme-Zinc.
2. VOC: (Unthinned) 2.67 lbs/gallon (320 grams/litre).
3. Performance Criteria:
a. Adhesion: ASTM D 4541 (TTM-34) Type II Fixed Alignment Adhesion Tester. No less than 1,516 psi (10.46 MPa) adhesion, average of three tests.
b. Adhesion: ASTM D4541 (TTM-34) Type V Self-Aligning Adhesion Tester. No less than 2,083 psi (6.89 MPa) pull.
c. Exterior Exposure: ASTM D 1014. No blistering, cracking, rusting or delamination of film. No more than 1/64” rust creepage at scribe after 5 years light industrial exposure.
d. Galvanic Protection: One coat aromatic urethane, zinc-rich coated steel panel containing several holidays is placed in a container of tap water. The panel’s potential is measured by a voltmeter with the positive (+) pole attached to a bare spot on the panel above the water line and the negative (-) pole attached to an Ag/AgC1 referenced electrode immersed in the tap water. True theoretical galvanic action of the zinc having actual zinc-to-zinc contact would show a

potential of 1100 millivolts. A range of 1100 millivolts to 750 millivolts would indicate galvanic action is occurring. The optimum potential is 850 millivolts. A potential of 500 millivolts or less would indicate that the coating is only acting as a barrier coating. The average measured potential of 90-97 is 878 millivolts.

e. Humidity: ASTM D 4585. No blistering, cracking, rusting or delamination of film after 4,000 hours exposure.

f. Salt Spray (Fog): ASTM B 117. No blistering, cracking, or delamination of film. No more than 1% rusting on plane and no more than 1/4" rust creepage at scribe after 20,000 hours exposure. No more than 1/32" rust creepage at scribe after 10,000 hours exposure. No more than 1/16 to 1/8" rust creepage at scribe and no more than 1% rusting on plane after 50,000 hours.

g. Prohesion: ASTM G 85 Prohesion Cabinet Testing. No blistering, cracking, rusting or delamination of film. No more than 1/64" creepage at scribe after 15,000 hours.

h. Static Fatigue (Slip Coefficient & Tension Creep). Meets the requirements of a Class B surface with a mean slip coefficient no less than 0.50 and a tension creep not in excess of .005 inch (.13 mm).

2.4 EPOXY COATINGS:

A. Inorganic Hybrid Water-Based Epoxy:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Tnemec Series 27 WB Typoxy.
2. VOC: 0.10 lbs/gallon (11 grams/litre).
3. Performance Criteria:
   a. Abrasion: ASTM D 4060, (CS-17 Wheel, 1,000 grams load). No more than 175 mg loss after 1,000 cycles.
   b. Adhesion: ASTM D 3359, (Method B, mm Crosshatch). No less than a rating of 5.
   c. Humidity: ASTM D 4585. No blistering, cracking, rusting or delamination of film after 4,500 hours exposure.
   d. Salt Spray (FOG): ASTM B 117. No blistering, cracking, rusting or delamination of film after 6,000 hours.
   e. Immersion: ASTM D 870. No blistering, cracking, rusting or delamination of film after 2,000 hours.

2.5 FLUOROPOLYMER COATINGS:

A. Fluoropolymer, Pigmented Coating:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Tnemec Series 1071 Fluoronar.
2. VOC: 2.65 lbs/gallon (317 grams/litre).
3. Performance Criteria:
   a. Abrasion: ASTM D4060, (CS-17 Wheel, 1,000 grams load). No more than 103 mg loss after 1,000 cycles.
   b. Adhesion: ASTM D 4541 (Method B, Type II Tester). No less than 1,333 psi (9.19 MPa) pull, average of three tests.
   c. Adhesion: ASTM D 4541 (Method E, Type V Tester). No less than 1,930 psi (13.3 MPa) pull, average of three tests.
   d. Exterior Exposure: Exposed at 45 degrees facing south. No blistering, cracking, rusting or delamination of film. No less than 87% gloss retention (8.9 units gloss change) and 2.99 DED FMCII (MacAdam units) color change after 24 months.

e. Exterior Exposure: ASTM D 4141, Method C (EMMAQUA). No blistering, cracking or chalking. No less than 96% gloss retention (3.2 units gloss change) and 0.18 DED Hunter Lab color change after 1,260 M/J m2 EMMAQUA exposure,
average of five tests in five colors.

f. Flexibility: ASTM D 522 (Method A – Conical Mandrel). No less than 14.83% elongation average of three tests.

g. Hardness: ASTM D 3363. No gouging or scratching with an 8H or less pencil.

h. Humidity: ASTM D 4585. No blistering, cracking, rusting or delamination of film after 3,000 hours exposure.

i. Impact: ASTM D 2794. No visible cracking or delamination of film after 34.6 inch/pounds (3.9J) or less direct impact.

j. QUV: ASTM D 4587 (UVA-340 Bulbs, Cycle 4:8 hours UV/4 hours condensation). No blistering, cracking, or chalking. No less than 93% gloss retention (5.7 units gloss change) and 2.21 DED FMCII (MacAdam Units) color change after 10,000 hours exposure, average of five tests in five colors. No blistering, cracking, or chalking. No less than 60% gloss retention (31.4 units gloss change) and 1.89 DED FMCII (MacAdam Units) color change after 25,000 hours exposure, average of five tests in five colors.

k. Salt Spray (Fog): ASTM B 117. No blistering, cracking, rusting or delamination of film. No more than 1/32 inch rust creepage at scribe after 10,000 hours exposure. No blistering, cracking, rusting or delamination of film. No more than 1/8 inch rust creepage at scribe after 10,000 hours exposure. No blistering, cracking, rusting or delamination of film. No more than 1/16 inch rust creepage at scribe after 10,000 hours exposure.

l. Weatherometer Exposure: ASTM D 5031. No blistering, cracking, or chalking. No less than 92% gloss retention (6 units gloss change) and 0.73 DED Hunter Lab Scale color change after 5,000 hours exposure.

2.6 SOURCE QUALITY CONTROL:

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for conditions affecting performance of the Work.

B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

C. Proceed with coating application only after unsatisfactory conditions have been corrected.
   1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION:

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions.
   1. Clean surfaces with pressurized water. Use pressure range of 100 to 600 psi (690 to 4140 kPa) at 6 to 12 inches (150 to 300 mm).

E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
   1. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
   2. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

3.3 APPLICATION:

A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
   1. Use applicators and techniques suited for coating and substrate indicated.

2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 CLEANING AND PROTECTION:

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.5 ONE-YEAR INSPECTION:

A. Owner will set date for one-year inspection of coating systems.

B. Repair deficiencies in coating systems as determined by Architect in accordance with manufacturers' instructions.

3.6 INTERIOR - CONCRETE AND CONCRETE MASONRY UNITS:

A. CMU Walls:
1. System Type: Inorganic Hybrid Water-Based Epoxy/Ceramic-Modified Waterborne Aliphatic Polyurethane.
2. Surface Preparation: SSPC-SP 13/NACE 6. Clean and dry.
3. Sealer Coat: Coverage rate 60 to 80 square feet per gallon.
4. Intermediate Coat: DFT 6.0 to 8.0 mils. or 200 to 267 SF^2/gal.5.
5. Finish Coat: DFT 2.0 to 3.0 mils. or 305 to 457 SF^2/gal.
6. Finish Color: As selected by Architect from manufacturer's standard colors.

3.7 EXTERIOR AND INTERIOR – COATING SYSTEMS FOR STEEL:

A. Exposed Steel, Columns, metal deck, bollards, tube railings:
   1. System Type: Zinc/ Inorganic Hybrid Water-Based/Fluoropolymer.
   2. Surface Preparation: SSPC-SP 6/NACE 3.
   3. Shop Primer: DFT 2.5 to 3.5 mils. or 289 to 404 SF^2/gal.
   4. Intermediate Coat: DFT 3.0 to 4.0 mils. or 401 to 535 SF^2/gal.
   5. Finish Coat: DFT 2.0 to 3.0 mils. or 321 to 481 SF^2/gal.
   6. Total DFT: 7.5 to 10.5 mils.
   7. Finish Color: As selected by Architect from manufacturer's standard colors.

END OF SECTION 099600

SECTION 101100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Markerboards.
2. Tackboards.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4 and 16a-38k-4(b)5
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 DEFINITIONS

A. Tackboard: Framed or unframed, tackable, visual display board assembly.

B. Visual Display Board Assembly: Visual display surface that is factory fabricated into composite panel form, either with or without a perimeter frame; includes chalkboards, markerboards, and tackboards.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of panel joints.
2. Show locations of special-purpose graphics for visual display surfaces.
3. Include sections of typical trim members.

D. Samples for Initial Selection: For each type of visual display surface indicated, for units with factory-applied color finishes, and as follows:

1. Actual sections of porcelain-enamel face sheet and tackboard assembly
2. Fabric swatches of polyester-fabric-faced tack assemblies.
3. Include accessory Samples to verify color selected.

E. Product Schedule: For visual display surfaces. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.

C. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Visual Display Units to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

B. Warranty: For Visual Display Units specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of motor-operated, sliding visual display units required for this Project.

B. Source Limitations: Obtain visual display surfaces from single source from single manufacturer.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-built visual display surfaces**,** including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.

B. Store visual display surfaces vertically with packing materials between each unit.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Surfaces lose original writing and erasing qualities.
    b. Surfaces exhibit crazing, cracking, or flaking.
2. Warranty Period: Life of the building.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.

1. Matte Finish: Low reflective; chalk wipes clean with dry cloth or standard eraser.
2. Gloss Finish: Gloss as indicated; dry-erase markers wipe clean with dry cloth or standard eraser.

B. Natural Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish with surface-burning characteristics indicated

C. Polyester Fabric: Nondirectional weave, 100 percent polyester; weighing not less than 15 oz./sq. yd. (508 g/sq. m); with surface-burning characteristics indicated.

D. Hardboard: ANSI A135.4, tempered.

E. Particleboard: ANSI A208.1, Grade M-1**,** made with binder containing no urea formaldehyde.

F. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.

2.2 MARKERBOARD ASSEMBLIES

A. Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and 0.021-inch- (0.53-mm-) thick, porcelain-enamel face sheet with low-gloss finish.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Best-Rite Manufacturing.
   b. Claridge Products and Equipment, Inc.
   c. PolyVision Corporation; a Steelcase company.

2. Particleboard Core: 3/8 inch (9.5 mm) thick; with 0.015-inch- (0.38-mm-) thick, aluminum sheet backing.
3. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.

2.3 TACKBOARD ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Best-Rite Manufacturing.
2. Claridge Products and Equipment, Inc.
3. PolyVision Corporation; a Steelcase company.

B. Polyester-Fabric-Faced Tackboard : 1/4-inch- (6-mm-) thick, polyester-fabric-faced cork sheet factory laminated to 1/4-inch- (6-mm-) thick hardboard or particleboard backing.

2.4 FABRICATION

A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.

B. Visual Display Boards: Factory assemble visual display boards unless otherwise indicated.

1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.

C. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.

1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
2. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.

D. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.

1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine walls and partitions for proper preparation and backing for visual display surfaces.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair the performance of and affect the smooth, finished surfaces of visual display boards, including dirt, mold, and mildew.

3.3 INSTALLATION, GENERAL

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

1. Mounting Height 36 inches (914 mm) above finished floor to top of chalktray.

3.4 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY BOARDS AND ASSEMBLIES

A. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches (400 mm) o.c. Secure both top and bottom of boards to walls.

1. Field-Applied Aluminum Trim: Attach trim over edges of visual display boards and conceal grounds and clips. Attach trim to boards with fasteners at not more than 24 inches (610 mm) o.c.

a. Attach chalktrays to boards with fasteners at not more than 12 inches (300 mm) o.c.

3.5 CLEANING AND PROTECTION

A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 101100

SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary General Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUBMITTALS: The following outlines submittal requirements unique to this section of the work, especially shop drawing content and samples

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. After award of contract, but prior to the beginning of detailed shop drawings, submit drawings showing typical details of connections. The Contractor shall arrange to meet with Architect and Architect's representative approximately one (1) week after submittal to review drawings and coordinate comments. The typical details as accepted shall be used to control detail design, shop drawing preparation and approval.

C. Shop drawings:

1. Submit complete shop drawings for manufactured and fabricated items. Indicate materials, layouts, sizes, methods, finishes, footings and anchorage devices, connections and other details of construction, as well as the relation to supporting and adjacent work where applicable. Exact identification of the paint or ink shall be noted on the shop drawings along with method of application. Create and confirm layout conditions not shown on the contract documents.

a. Identify all pre-fabricated products proposed for use.

b. Indicate manufacturer, brand name, quality and type paint for each surface to be finished.

c. Submit complete shop drawings and erection drawings conforming to all current applicable industry standards and local codes. Preparation of shop drawings shall not be sublet without the written permission of Architect.

D. Details shown are for concept purposes only; the sign contractor shall submit drawings of sign connection details; drawings shall be stamped and computations shall be prepared by a registered professional engineer in the state of Connecticut and shall cover all members, connections (welds, bolts, etc.) indicating such meets the design specifications for sign structures stress requirements and wind load deflection tolerances.

E. Samples: Submit two samples of each of the following, unless otherwise specified:

1. Finishes:

a. Submit 4" x 4" samples of each finish specified. Submit five (5) of each finish.

b. Surface-applied graphics shall be on actual substrate upon which they will appear.

c. Hardware items: Submit samples of each type of anchor, insert or other fastener as requested by Architect.

F. Submit for review, approval and demonstration of representative craftsmanship ONE (1) of the following sign types. Sign types shall be an actual sign unit that may be installed on the project site after approval or correction.

A Monument Sign (representative section only)
B Building ID Signage (BUS SYMBOL)
C Bus Entrance ID Letters (1 letter)
D Employee Entry ID Letters (1 letter)
E Vehicular Directional Sign (representative section only)
F Garage Clearance Bar (representative section only)
G Maintenance Area ID Sign (representative section only)
H Exterior Door ID Plaque
I Garage Vehicular Directional Sign (representative section only)
J Corridor Entrance Graphics (representative section only)
K Bus Lane ID Sign
L Elevator Lobby Directory
M Elevator Cab Directory
N Restroom ID Plaque
O Stair ID Plaque
P Loading Dock ID Sign
Q General Room ID Plaque
R Office ID Plaque
S Bus Bay ID Sign
T Site Regulatory Sign (post sample and HC Pkg panel only)
U Administration Area Graphic (representative section only)
V Building Graphic (representative section only)
W Dimensional Letters (1 letter)

G. Submit for review, approval and demonstration of representative craftsmanship ONE (1) of the following sign types to be retained by design team as a control sample.

C Bus Entrance ID Letters (1 letter)
D Employee Entry ID Letters (1 letter)
K Bus Lane ID Sign
L Elevator Lobby Directory
N Restroom ID Plaque
P Loading Dock ID Sign
R Office ID Plaque

H. Scheduling: Submit the final schedule for construction of work and installation within ten (10) days of sample approvals. Indicate dates of completion for prototypical units for approval, dates of partial deliveries and total completion. Dates given shall be consistent with the time requirements submitted with the bid.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For the signage identified to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For signage specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 DELIVERY, STORAGE AND HANDLING

A. Maintain neat, clean conditions in all building areas; remove trash, rags and waste materials at end of each day's work. Protect the floor and wall surfaces of this space against damage or defacement.

B. Close any open containers at end of day's work. Leave no materials open.

C. Acrylic and other glazing materials or finish materials with or requiring protective wrapping shall only have this protection removed as required during fabrication and installation and once the area is clear of work or activities which might cause damage to the installed work. Care shall be taken in handling surfaces and products to prevent scratching, chipping, or cracking.

D. Store materials a minimum of 4" above ground on framework or blocking and cover with protective waterproof covering. Provide air circulation and ventilation. Store in dry, conditioned space.

1.5 QUALITY CRITERIA

A. Fabricators shall meet the following criteria:

1. Sign contractors and/or subcontractors shall have been regularly engaged in the manufacture, fabrication and installation of sign systems of comparable scope and quality for a minimum of five (5) years.

2. Sign contractors and/or subcontractors shall submit a minimum of five (5) references listing project type, scope of work, Architect and date of completion, Owner's address and telephone number.

1.6 JOB CONDITIONS

A. Environmental requirements:

1. Comply with manufacturer's recommendation regarding environmental conditions under which materials may be applied.

2. Apply no adhesive or coating materials in spaces where dust is being generated.

B. Coordination: Coordinate work with the work of other sections of the specifications to ensure that surfaces to receive signs are properly completed, inspected, and approved prior to commencement of work. Commencement of work in any space shall constitute acceptance by the Contractor of surfaces to receive identifying devices.

1.7 WARRANTIES

A. Warrant vinyl film for a period of five (5) years from Date of Material Completion against delamination from the substrate.

B. Paints or inks and finishes shall be guaranteed not to cause discoloration, deterioration, or delamination of any materials used in fabrication. Warrant paint finishes on metal and plastic materials for a period of five years from the date of Material completion.

C. Warranty Provisions: During the warranty period, restore defective work to the standard of the contract documents without cost to the Using Agency, including all labor, materials, refinishing and all costs incidental to the work.

D. Warrant all electrical components and signs for a period of at least one year, parts and labor, or greater if stipulated elsewhere in the specification section for electrical work.

1.8 GRAPHICS, ARTWORK AND ELECTRONIC FILES:

A. The Architect or their consultants shall only furnish artwork in an electronic form if it already exists or was created in that form during the course of designing the project. Formats for graphic designs shall be in that of its original creation and may be manual or photo-mechanical or electronic/digital, and if digital, are likely to have been prepared in graphic design industry standard computer software on Macintosh™ platform computer hardware. Contract document drawings or layouts for the work shall not be transferred or transmitted to the contractor.

PART 2 - PRODUCTS

2.1 CUSTOM SIGNAGE

Provide architectural quality custom signage seamlessly fabricated per design intent drawings.

A Monument Sign
B Building ID Letters
C Bus Entrance ID Letters
D Dimensional ID Letters
E Vehicular Directional Sign
F Garage Clearance Bar
G Maintenance Area ID Sign
H Exterior Door ID Plaque
I Garage Vehicular Directional Sign
J Corridor Entrance Graphics
K Bus Lane ID Sign
L Elevator Lobby Directory
M Elevator Cab Directory
N Restroom ID Plaque
O Stair ID Plaque
P Loading Dock ID Numeral/Text
Q General Room ID Plaque
R Office ID Plaque
S Bus Bay Entrance Graphic
T Site Regulatory Sign
U Administration Area Graphic
V Building Graphic
W Dimensional Letters

2.2 METALS

A. Metal letterforms

1. Fabricated letters from aluminum shall be heliarc welded in conformance with the American Welding Society and the Aluminum Association's specifications. Metal shall be 3003H14 or 60601 alloy.
2. Fabricated letters shall be braced internally where necessary to be free from waves, buckles, or warps.

2.3 ACCESSORIES:

A. Anchors and fasteners:

1. Anchors, inserts or fasteners shall be compatible with sign materials, shall not result in galvanic action or chemical interaction of adhesives and shall have demonstrable and sufficient strength for intended use.

2. Anchors and fastenings for aluminum shall be stainless steel, zinc or cadmium coated steel. Anchors and fasteners shall be concealed where possible. Indicate locations on shop drawings.
3. Anchors and fastenings for exterior use shall be galvanized steel in accordance with ASTM A153-82.
4. Wherever possible, anchors to concrete and masonry shall be cast-in-place. Use expansion shields where anchors cannot be located before concrete is poured.
5. Fasteners to solid masonry and concrete shall be one of the following:
   a. flat-head drop-in expansion bolts.
   b. Powder-actuated fasteners; appropriate size drive pin for concrete and for masonry.
   c. Fasteners to cells of hollow masonry shall be drive pins of the appropriate size.
   d. Fasteners to roll or formed steel members shall be powder-actuated fasteners of the appropriate size.
   e. Fasteners to metal deck shall be self-drilling, self-tapping screws.
   f. Expansion shields shall be machine bolt type, tubular type, or self-drilling tubular type.
6. Anchor bolts for wood blocking to concrete and masonry shall be the appropriate size steel for masonry, unless otherwise noted, and installed with washer and nut at both ends.
7. Anchor bolts for wood blocking to steel members shall be appropriate size steel and installed with washer and nut.
8. Install using miscellaneous anchors and fasteners as required to secure work in place.

2.4 COATINGS (PAINTS):

A. Paint and colors to be finalized in 100% submittal

B. Refer to manufacturers standards for paint finishes and preparation

PART 3 EXECUTION

3.1 INSPECTION

A. Inspection of substrates:
   1. Surfaces to receive identifying devices shall be free from defects and imperfections that would prevent an acceptable installation.
   2. Commencing of work in any space shall constitute acceptance by the Contractor of surfaces to receive identifying devices as being in a satisfactory condition to permit an acceptable installation. If the Contractor's inspection of such surfaces discloses unsatisfactory conditions, he shall notify the Architect in writing and await further instruction; otherwise, no claims will be considered for unsatisfactory work due to real or alleged faulty surfaces.

3.2 PREPARATION AND PROTECTION:

A. Protect the work and adjacent work and materials against damage during progress of work until completion. Drop cloths of paper or plastic shall be used around all areas where paint is being applied and appropriate precautions shall be taken to prevent overspray, hazardous conditions or damage to adjacent work.

3.3 INSTALLATION, APPLICATION:

A. Installation of sign panels and graphic units:

1. Erect, mount or install all panels and units to be level, plumb and true.
2. Use sufficient concealed fasteners and anchors to hold sign panels and graphic units in place. Use only concealed shims. Visible fasteners may only be used where approved in shop drawings or as part of an intentional design detail.
3. Make Architect aware of conflicts in sign locations as shown in the drawings.
4. Mount all room identification sign panels at 60” AFF to centerline of sign and 2” from latch-side door jamb.

3.4 ADJUSTING, CLEANING AND PROTECTION:

A. Remove and replace damaged identifying devices with new identifying devices free of defects.

B. Clean exposed surfaces promptly after completion of installation in accordance with recommendations of manufacturer.

C. Clean exposed metal work with cleanser recommended by manufacturer of materials and rinse with clean water. Do not use harsh chemicals or abrasive. Surfaces with stains which cannot be removed by cleaning shall be refined or replaced to the satisfaction of Architect at no extra cost to Using Agency.

D. Signs shall be free of tape, packing paper, dirt, smudges, and other foreign material.

E. Spatters, drippings, smears, and / or spray shall be completely removed.

F. Plastic surfaces shall be cleaned upon completion in accordance with manufacturer's instructions. Supply one pint of manufacturer's recommended cleaner for Using Agency's use.

G. Touch up work after installation shall be performed by the sign manufacturer and approved by Architect.

H. Protection:

1. Work in progress shall be protected at all times from staining, scratching, chipping or other damage until acceptance by the Architect.
2. Provide final protection in a manner acceptable to the fabricator and installer until Date of Substantial Completion.

3.5 SIGN QUANTITIES AND UNIT PRICING

A. Provide ITEMIZED bid including shipping, delivery, installation, etc.

B. Provide unit costs good for up to 1 year in the event or additions or re-orders.

3.6 SIGN LOCATIONS AND MESSAGES:

A. Refer to sheets AS100 – AS103 for Sign Location Plans. A preliminary draft of the corresponding sign messages is provided in the attached Sign Message Schedule.

B. Refer to sheet AS201 and AS202 for typical sign face layouts, materials, fabrication notes and installation conditions.

END OF SECTION 10 1400

SECTION 102113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Stainless-steel toilet compartments configured as toilet enclosures and urinal screens.

B. Related Sections:

   1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4 and 16a-38k-4(b)5
      a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

   2. Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
   1. Show locations of reinforcements for compartment-mounted grab bars.
   2. Show locations of centerlines of toilet fixtures.

D. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.

E. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

   1. Each type of material, color, and finish required for units, prepared on 6-inch- (152-mm-) square Samples of same thickness and material indicated for Work.
   2. Each type of hardware and accessory.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Toilet Compartments to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 76-200.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1for toilet compartments designated as accessible.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).

C. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.

1. Electrolytically Zinc Coated: ASTM A 879/A 879M, 01Z (03G).
2. Hot-Dip Galvanized: ASTM A 653/A 653M, either hot-dip galvanized or galvannealed.

D. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

E. Stainless-Steel Castings: ASTM A 743/A 743M.

F. Zamac: ASTM B 86, commercial zinc-alloy die castings.

2.2 STAINLESS-STEEL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Partitions Mfg. Corp.
2. Global Steel Products Corp.
3. Hadrian Manufacturing Inc.

B. Toilet-Enclosure Style: Floor anchored-overhead braced.

C. Urinal-Screen Style: Floor anchored.

D. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. Provide with no-sightline system. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.

1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch (25 mm) for doors and panels and 1-1/4 inches (32 mm) for pilasters.
2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units.
3. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.

E. Urinal-Screen Construction:

1. Flat-Panel Urinal Screen: Matching panel construction.

F. Facing Sheets and Closures: Stainless-steel sheet of nominal thicknesses as follows:

1. Pilasters, Braced at Both Ends: Manufacturer's standard thickness, but not less than 0.038 inch (0.95 mm).
2. Pilasters, Unbraced at One End: Manufacturer's standard thickness, but not less than 0.050 inch (1.27 mm).
3. Panels: Manufacturer's standard thickness, but not less than 0.031 inch (0.79 mm).
4. Doors: Manufacturer's standard thickness, but not less than 0.031 inch (0.79 mm).
5. Flat-Panel Urinal Screens: Thickness matching the panels.

G. Pilaster Shoes and Sleeves (Caps): Stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.

H. Urinal-Screen Post: Manufacturer's standard post design of material matching the thickness and construction of pilasters; with shoe and sleeve (cap) matching that on the pilaster.

I. Brackets (Fittings):
   1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel .

J. Stainless-Steel Finish: No. 4 satin (brushed)finish on exposed faces. Protect exposed surfaces from damage by application of strippable, temporary protective covering before shipment.

K. Pattern: Embossed.

2.3 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

   1. Material: Stainless steel.
   2. Hinges: Manufacturer's standard continuous, cam type that swings to a closed or partially open position.
   3. Latch and Keeper: Manufacturer's standard recessed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
   4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
   5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
   6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.4 FABRICATION

A. Floor anchored, overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

B. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.

C. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch (13 mm).
b. Panels and Walls: 1 inch (25 mm).

2. Continuous Brackets: Secure panels to walls and to pilasters with continuous brackets fastened at locations recommended by the manufacturer.

a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

B. Floor anchored, overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Warm-air dryers.
4. Underlavatory guards.
5. Custodial accessories.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 088300 "Mirrors" for frameless mirrors.
3. Section 093000 "Tiling" for ceramic toilet and bath accessories.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include the following:
1. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
2. Material and finish descriptions.
3. Features that will be included for Project.
4. Manufacturer's warranty.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify products using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Toilet, Bath and Laundry Accessories to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

B. Warranty: For Toilet, Bath and Laundry Accessories specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.8 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Toilet Tissue (Jumbo-Roll) Dispenser (TTD):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc., Model B-2890.
2. Description: One-roll unit.
3. Mounting: Surface mounted.
4. Capacity: 10-inch- (228- or 254-mm-) diameter roll.
5. Material and Finish: Stainless steel, No. 4 finish (satin).
6. Lockset: Tumbler type.
7. Refill Indicator: Pierced slots at front.

B. Combination Towel (Folded) Dispenser/Waste Receptacle (PTD):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc., Model B-380349.
2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
3. Mounting: Surface mounted.
4. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
5. Minimum Waste-Receptacle Capacity: 3.8 gal. .
6. Liner: Reusable, vinyl waste-receptacle liner.
7. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.

C. Liquid-Soap Dispenser (SD):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc., Model B-2111 .
2. Description: Designed for dispensing soap in liquid or lotion form.
3. Mounting: Vertically oriented, surface mounted.
4. Capacity: 40 fl. oz. .

5. Materials: Stainless steel with No.4 finish. Black molded plastic push button and spout..
6. Lockset: Tumbler type.
7. Refill Indicator: Window type.

D. Grab Bar (GB and VGB):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc., Model B-6806.99 Series.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 18- gauge (1.2 mm) thick.

   a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.

4. Outside Diameter: 1-1/2 inches (38 mm).
5. Configuration and Length: As indicated on Drawings.

E. Swing Grab Bar (SGB):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc., Model B-4998.99
2. Mounting: Backplate with four screw holes for attachment to wall.
3. Material: Stainless steel, 18- gauge (1.2 mm) thick.

   a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.

4. Outside Diameter: 1-1/4 inches (32 mm).
5. Length: 29 inches.

F. Mirror Unit (MR):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc., Model B-290 Series.
2. Frame: Stainless-steel angle.

   a. Corners: Welded and ground smooth.
3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
   a. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

4. Size: As indicated on Drawings.

2.3 PUBLIC-USE SHOWER ROOM ACCESSORIES

A. Shower Curtain and Rod (SC):

1. Basis-of-Design Products:
   a. Shower Curtain Rod: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc., Model B-6047 x 36 and B-6047 x 60.

b. Shower Curtain: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc., Model B-204-2 and 204-3.

2. Shower Current Rod Description: Size: 1-1/4-inch (32-mm) OD; fabricated from nominal 0.05-inch- (1.3-mm-) thick stainless steel.
3. Shower Curtain Rod Mounting Flanges: Stainless-steel flanges designed for exposed fasteners.
4. Shower Curtain Rod Finish: No. 4 (satin).
5. Shower Curtain Size: Minimum 6 inches (152 mm) wider than opening by 72 inches (1828 mm) high.
6. Shower Curtain Material: Vinyl, minimum 0.008 inch thick, opaque, matte with hemmed edges and corrosion resistant grommets at min. 6 inches o.c. through hem.
7. Color: White.
8. Grommets: Corrosion resistant at minimum 6 inches (152 mm) o.c. through top hem.
9. Shower Curtain Hooks: Chrome-plated or stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

B. Folding Shower Seat (SS):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc., Model B-5181.

2. Configuration: L-shaped seat, designed for wheelchair access.
3. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect..
4. Frame and Mounting Bracket: Stainless steel, with self-locking mechanism..
5. Dimensions: 33 inches wide x 22 inches deep..
6. Supports minimally 360 lbs.

C. Soap Holder (SH):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc., Model B-680.
2. Description: Without washcloth bar.
3. Mounting: Surface mounted.
4. Material and Finish: Stainless steel, No. 4 finish (satin).

D. Clothes or Coat Hook (CH):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc., Model B-2116.
2. Description: Single-prong unit.

E. Material and Finish: Solid brass, satin nickel plated.Towel Pin (TP):
1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc., Model B-6777.
2. Description: Projecting minimum of 3 inches (75 mm) from wall surface.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

2.4 WARM-AIR DRYERS

A. Warm-Air Dryer (HD):

1. Basis-of-Design Product: Subject to compliance with requirements, provide XLERATOR, Model XL-SB; Excel Dryer Corporation.
2. Mounting: Recessed. Provide manufacturers standard recess kit.
3. Operation: Electronic-sensor activated with timed power cut-off switch.

    a. Operation Time: 30 to 40 seconds.

4. Cover Material and Finish: Stainless steel, No. 4 finish (satin).
5. Electrical Requirements: 115 V, 13 A, 1500 W.

2.5 UNDERLAVATORY GUARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. McGuire Manufacturing, Inc.
2. Plumberex Specialty Products, Inc.
3. Truebro by IPS Corporation.

B. Underlavatory Guard :

1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded plastic, white.

2.6 CUSTODIAL ACCESSORIES

A. Mop and Broom Holder (MBH):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment; Model 244.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 36 inches (914 mm).
4. Hooks: Three.
5. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, No. 4 finish (satin).

    a. Shelf: Not less than nominal 0.05-inch (1.3-mm) thick stainless steel.
    b. Rod: Approximately 1/4-inch (6-mm) diameter stainless steel.

2.7 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 102800

SECTION 10300- DOORWAY SPILL BARRIER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Manual closing doorway spill barriers.

1.3 QUALITY ASSURANCE

A. Experience: Equipment shall be produced by a manufacturer of established reputation with a minimum of five years experience supplying specified equipment.

B. Each product shall be provided by a single manufacturer.

C. All components shall be factory tested and documented to operate as a complete system

D. Manufacturer's Representative: The manufacturer authorized representative shall be factory trained and certified personnel providing service, startup, and quality control field labor for the project from their local office.

1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out and start up.

2. Training: Provide technical representative to train Owner's maintenance personnel in operation and maintenance of specified equipment.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location.
2. Indicate locations, dimensions, and profiles of wall and floor reinforcements.
3. Indicate locations and installation details of built-in anchors.

D. Field test reports, indicating and interpreting test results relative to compliance with specified requirements, for information.

E. Sample Warranty- warranty information for each piece of equipment and contractors general warranty.

F. Operation and Maintenance Manual:

1. Provide a Complete parts list, operating instructions, and maintenance manual covering equipment at time of installation including, but not limited to:

a. Description of system and components.
b. Provide approved submittal as part of O&M clearly identifying manufacturer and provided model number.
c. Manufacturer's printed operating instructions.
d. Printed listing of periodic preventive maintenance items and recommended frequency required to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.
e. List of original manufacturer's parts, including suppliers' part numbers and cuts, recommended spare parts stockage quantity and local parts and service source.
f. Include vendor contact information for service and warranty
g. Include all testing reports

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Drawn to scale, and coordinated with door openings.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Seals: One set(s) for each size unit.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Doorway Spill Barrier to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

B. Warranty: For Doorway Spill Barrier specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.8 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, function and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough, or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid, dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Mark Number of this specification.

C. Provide equipment and materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

PART 2 – PRODUCTS

2.1 MANUAL CLOSING DOORWAY SPILL BARRIERS

A. Doors S110-1, M115-1:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model R10-0312; Denios Inc.

a. Sealed width: 40 inches.
b. Overall dimensions: 48 inches wide by 28 inches deep by 37 inches high.
c. Barrier height; 12 inches of liquid retention behind the closed barrier.
d. Construction: Galvanized steel, HRS.
e. Seals: PTFE encapsulated seals, temperature resistant and inert to most chemicals.
f. Load capacity: 3.25 tons per wheel = 6.5 tons.
g. Safety procedures: Surface / Cover Plate provided with anti-skid diamond plate.

B. Door M115-2:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model R11-0612; Denios Inc.

a. Sealed width: 76 inches.
b. Overall dimensions: 96 inches wide by 22 inches deep by 37 inches high.
c. Barrier height; 12 inches of liquid retention behind the closed barrier.
d. Construction: AISI 304 stainless steel.

e. Finish: natural, mat finish stainless steel, glass beaded blasted to provide uniform scratch free surface.
f. Seals: PTFE encapsulated seals, temperature resistant and inert to most chemicals.
g. Sump Depth: 6 inches.
h. Load capacity: 3.25 tons per wheel = 6.5 tons.
i. Safety procedures:

1) Surface / Cover Plate provided with anti-skid diamond plate.
2) Vertical piers on either side of opening provided with yellow and black diagonal visual warning stripes.

C. Door M115-3:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model R11-1212; Denios Inc.

a. Sealed width: 148 inches.
b. Overall dimensions: 168 inches wide by 22 inches deep by 37 inches high.
c. Barrier height; 12 inches of liquid retention behind the closed barrier.
d. Construction: AISI 304 stainless steel.
e. Finish: natural, mat finish stainless steel, glass beaded blasted to provide uniform scratch free surface.
f. Seals: PTFE encapsulated seals, temperature resistant and inert to most chemicals.
g. Sump Depth: 6 inches.
h. Load capacity: 3.25 tons per wheel = 6.5 tons.
i. Safety procedures:

1) Surface / Cover Plate provided with anti-skid diamond plate.
2) Vertical piers on either side of opening provided with yellow and black diagonal visual warning stripes.

PART 3 - EXECUTION

3.1 INSPECTION

A. Coordinate location of rough-in work to assure match with equipment to be installed.

B. Inspect delivered equipment for damage from shipping and exposure to weather.

C. Compare delivered equipment with packing lists and specifications to assure receipt of all items.

3.2 INSTALLATION

A. Install equipment in accordance with plans, shop drawings and manufacturer's instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level, plumb and at right angles to adjacent work.

2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.

3. Anchorage: Attach equipment securely as per manufacturers written instructions, to prevent damage resulting from inadequate fastening.

4. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.3 TESTING

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections, check operation of the equipment and components for operation and performance as specified and examine the finish for damage. Provide report in writing that the installation meets the requirements and shall include information concerning minor adjustments and minor repairs, which may be required before final acceptance by the Owner.

2. Test and adjust controls. Replace damaged and malfunctioning controls and equipment

B. Prepare test and inspection reports

3.4 CLEANUP

A. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

B. Clean area around equipment installation and remove packing or installation debris from job site.

3.5 TRAINING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment

END OF SECTION 103000

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire protection cabinets for the following:

a. Portable fire extinguishers.
b. Fire hose valves.
c. Fire department access panel

B. Related Sections:

1. Section 101400 "Signage" for directional signage to out-of-sight fire extinguishers and cabinets.
2. Section 104416 "Fire Extinguishers."
3. Section 211200 "Fire Suppression Standpipes" for hose systems and valves.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.

1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
2. Show location of knockouts for hose valves.

C. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

D. Samples for Initial Selection: For each type of fire protection cabinet indicated.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Fire Protection Cabinets to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

1.5 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire hoses, hose valves, and hose racks indicated are accommodated.

C. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless-Steel Sheet: ASTM A 666, Type 304.

B. Copper-Alloy Bronze Sheet: ASTM B 36/B 36M, alloy UNS No. C28000 (muntz metal, 60 percent copper).

C. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.2 FIRE EXTINQUISHER CABINET (FEC)

A. Cabinet Type: Suitable for fire extinguisher.

1. Products: Subject to compliance with requirements, provide products by one of the following:

   a. J. L. Industries, Inc., a division of Activar Construction Products Group;
   b. Larsen's Manufacturing Company;
   c. Potter Roemer LLC.

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Stainless-steel sheet.

1. Shelf: Same metal and finish as cabinet.

D. Cabinet Types:

1. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
   a. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

2. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.
3. Locations: See drawings for cabinet type locations.

E. Cabinet Trim Material: Stainless-steel sheet.

F. Door Material: Stainless-steel sheet.

G. Door Style: Vertical duo panel with frame.

H. Door Glazing: Tempered float glass (bronze tint).

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide recessed door pull and friction latch.
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
   a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
      1) Location: Applied to cabinet door.
      2) Application Process: Engraved.
      3) Lettering Color: Black.
      4) Orientation: Vertical.

K. Finishes:

1. Stainless Steel: No. 4.

2.3 FIRE-HOSE CABINET (FHC)

A. Cabinet Type: Suitable for fire hose valve.

1. Products: Subject to compliance with requirements, provide products by one of the following:
   a. JL Industries, Inc.; a division of the Activar Construction Products Group.
   b. Larsens Manufacturing Company.
   c. Potter Roemer LLC.

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Stainless-steel sheet.

D. Recessed Cabinet (RFHC):
1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

E. Semi-recessed Cabinet (SRFHC): One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

1. Square-Edge Trim: 1-1/4- to 1-1/2-inch (32- to 38-mm) backbend depth.

F. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

G. Cabinet Trim Material: Stainless-steel sheet.

H. Door Material: Stainless-steel sheet.

I. Door Style: Vertical duo panel with frame.

J. Door Glazing: Tempered float glass (bronze tint.

K. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide recessed door pull and friction latch.
2. Provide concealed hinge permitting door to open 180 degrees.

L. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
3. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.

M. Materials:

1. Stainless Steel: ASTM A 666, Type 304.

a. Finish: No. 4 directional satin finish.

2. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 2 (tinted, heat absorbing, and light reducing), bronze tint.

2.4 FIRE DEPARTMENT ACCESS PANEL

A. Type: Surface mounted.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Model 4100; Knox Company.

B. Material: ¼ inch steel plate, ½ inch solid steel door with interior silicone gasket seal. Panel to have anti-theft re-locking mechanism with drill resistant plate lock protector.

C. Lock: UL Listed double-action rotating tumblers with hardened steel pins accessed by proprietary coded biased cut key. Provide min. 1/8 inch stainless steel dust cover with tamper seal mounting.

1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

D. Finish: Manufacturers standard powder coat.

E. Color: Aluminum.

F. Dimensions: Max. 6 inches high x 6 inches wide x 4 1/4" inches deep.

2.5 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

1. Fire Extinguisher Cabinets: Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
2. Hose Valve Cabinet: Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for hose valves and cabinets to verify actual locations of piping connections before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed and semi-recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below.

1. Fire Protection Cabinets: 54 inches (1372 mm) above finished floor to top of cabinet.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

C. Identification: Apply decals at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Related Requirements:

1. Section 104413 "Fire Protection Cabinets."

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

C. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Fire Extinguishers to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

B. Warranty: For Fire Extinguishers specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Failure of hydrostatic test according to NFPA 10.
   b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. JL Industries, Inc.; a division of the Activar Construction Products Group.
   b. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
   c. Larsens Manufacturing Company.

2. Valves: Nickel-plated, polished-brass body.
3. Handles and Levers: Stainless steel.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Wet-Chemical Type : UL-rated 2-A:1-B:C:K, 1.6-gal. (6-L) nominal capacity, in stainless-steel container; with pressure-indicating gage.

C. Multipurpose Dry-Chemical Type in Steel Container : UL-rated 3-A:40-B:C, 6-lb (2.7-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

D. Carbon Dioxide Type : UL-rated 10-B:C, 10-lb (4.5-kg) nominal capacity, with carbon dioxide in enameled-aluminum container.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

C. Locations: See drawings for fire extinguisher type locations.

END OF SECTION 104416

SECTION 105113 - METAL LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Welded wardrobe lockers.
2. Locker benches.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(d)9
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of metal locker.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker and bench.

C. Shop Drawings: For metal lockers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Show locker trim and accessories.
3. Include locker identification system and numbering sequence.

D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available.

E. Product Schedule: For lockers. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Metal Lockers to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

B. Warranty: For Metal Lockers specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures.
   b. Faulty operation of latches and other door hardware.

2. Damage from deliberate destruction and vandalism is excluded.
3. Warranty Period for Welded Metal Lockers: Lifetime from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain metal lockers**,** locker benches, and accessories from single source from single locker manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Requirements: For lockers indicated to be accessible, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1, 2003 with 2009 Connecticut Amendment.

2.3 WELDED WARDROBE LOCKERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. Art Metal Products; Champ Corridor.
2. Lyon Workspace Products, LLC; Integrated Frame.
3. Penco Products, Inc; All-Welded.

B. Doors: One piece; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.

1. Door Style: Vented panel as follows:

a. Louvered Vents: No fewer than six louver openings at top and bottom for single-tier, three louver openings at top and bottom for double-tier, two louver openings at top and bottom, or three louver openings at top or bottom, for triple-tier lockers.

C. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

1. Tops, Bottoms, and Sides: 0.060-inch (1.52-mm) nominal thickness.
2. Backs: 0.048-inch (1.21-mm) nominal thickness.
3. Shelves: 0.060-inch (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.

D. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.

E. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.

1. Continuous Hinges: Manufacturer's standard, steel, full height.

F. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.

1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks or padlocks; positive automatic latching and prelocking.

a. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks and doors less than 48 inches (1219 mm) high with two latch hooks; fabricated from 0.120-inch (3.04-mm) nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.

b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

G. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch (9 mm) high.

H. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.

I. Continuous Sloping Tops: Fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet, with a pitch of approximately 20 degrees.

1. Closures: Hipped-end type.

J. Recess Trim: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

K. Filler Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

L. Boxed End Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

M. Materials:

1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

N. Size: As indicated on the drawings.

O. Finish: Baked enamel or powder coat.

1. Color: As selected by Architect from manufacturer's full range.

2.4 LOCKER BENCHES

A. Provide bench units with overall assembly height of 17-1/2 inches (445 mm).

B. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.

1. Size: Minimum 9-1/2 inches wide by 1-1/4 inches thick (241 mm wide by 32 mm thick) except provide minimum 20-inch- (508-mm-) wide tops where accessible benches are indicated.
2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.

C. Fixed Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:

1. Tubular Steel: 1-1/4-inch- (32-mm-) diameter steel tubing, with 0.1265-inch- (3.2-mm-) thick steel flanges welded at top and base; with baked-enamel finish; anchored with exposed fasteners.

a. Color: As selected by Architect from manufacturer's full range.

D. Materials:
1. Steel Tube: ASTM A 500/A 500 M, cold rolled.

2.5 FABRICATION

A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.

C. Equipment: Provide each locker with an identification plate and the following equipment:

1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
2. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
3. Triple-Tier Units: One double-prong ceiling hook.

D. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.

E. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches (381 mm) above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches (1219 mm) above the floor.

F. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.

1. Sloping-top corner fillers, mitered.

G. Recess Trim: Fabricated with minimum 2-1/2-inch (64-mm) face width and in lengths as long as practical; finished to match lockers.

H. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

I. Boxed End Panels: Fabricated with 1-inch- (25-mm-) wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.

J. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.

K. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.

2.6 ACCESSORIES

A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.

B. Anchors: Material, type, and size required for secure anchorage to each substrate.

1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls for corrosion resistance.
2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install lockers level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
2. Anchor single rows of metal lockers to walls near top and bottom of lockers.
3. Anchor back-to-back metal lockers to floor.

B. Welded Lockers: Connect groups together with standard fasteners, with no exposed fasteners on face frames.

C. Equipment:

1. Attach hooks with at least two fasteners.
2. Attach door locks on doors using security-type fasteners.
3. Identification Plates: Identify metal lockers with identification indicated on Drawings.

a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.

D. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach recess trim to recessed metal lockers with concealed clips.
2. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
3. Attach sloping-top units to metal lockers, with closures at exposed ends.
4. Attach boxed end panels using concealed fasteners to conceal exposed ends of nonrecessed metal lockers.
5. Attach finished end panels using fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

E. Fixed Locker Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches (1830 mm) apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

3.3 ADJUSTING

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.

3.4 PROTECTION

A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105113

SECTION 106700- STORAGE EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

The General Provisions of the Contract, including General and Special Conditions, apply to the Work in this Section.

1.2 WORK INCLUDED

A. Equipment items as listed below by Equipment Mark Number:

1. BIN UNIT, 66 OPENING
   Equipment Mark Number: 1040
   Submittal requirements: PD

2. CABINET, 6 DRAWER, 33 INCH
   Equipment Mark Number: 1105
   Submittal requirements: PD

3. CABINET, 9 DRAWER, 59 INCH
   Equipment Mark Number: 1113
   Submittal requirements: PD

4. CABINET, FLAMMABLE MATERIALS, LARGE
   Equipment Mark Number: 1140
   Submittal requirements: PD

5. CABINET, STORAGE, SHOP, 18 INCH
   Equipment Mark Number: 1185
   Submittal requirements: PD

6. DESK, STAND-UP
   Equipment Mark Number: 1220
   Submittal requirements: PD

7. LADDER, SAFETY, ROLLING
   Equipment Mark Number: 1305 & 1310
   Submittal requirements: PD

8. RACK, GLASS
   Equipment Mark Number: 1500
   Submittal requirements: PD

9. RACK, PALLET
Equipment Mark Number: 1530
Submittal requirements: PD

10. RACK, TIRE
Equipment Mark Number: 1640
Submittal requirements: PD, OM

11. SHELVING UNIT, 18 INCH
Equipment Mark Number: 1680
Submittal requirements: PD

12. CABINET, MATERIALS STORAGE, AUTOMATED
Equipment Mark Number: 1725
Submittal requirements: PD, OM, SD, T

13. TABLE, LAYOUT, STEEL TOP
Equipment Mark Number: 1765
Submittal requirements: PD

14. TABLE, LAYOUT, WOOD TOP
Equipment Mark Number: 1776
Submittal requirements: PD

15. WORKBENCH, SEVERE USE
Equipment Mark Number: 1860
Submittal requirements: PD

16. BENCH, BATTERY
Equipment Mark Number: 2030
Submittal requirements: PD

17. CART, PARTS
Equipment Mark Number: 5030
Submittal requirements: PD

18. DOLLY, DRUM
Equipment Mark Number: 5290
Submittal requirements: PD

19. HOPPER, SELF DUMPING, 3/4 YARD
Equipment Mark Number: 5460
Submittal requirements: PD, OM, T

20. BUS TIRE CAROUSEL
Equipment Mark Number: 5121
Submittal requirements: PD, OM, SD, T

21. PARATRANSIT TIRE CAROUSEL
Equipment Mark Number: 5122
Submittal requirements: PD, OM, SD, T

A. Roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.

1. Coordinate and verify all electrical and utility connections with all trades prior to equipment ordering and purchase.

B. Piping, wiring, and switching between equipment and utilities.

1.3 QUALITY ASSURANCE

A. All components shall be factory tested and documented to operate as a complete system

B. Manufacturer's Representative: The manufacturer authorized representative shall be factory trained and certified personnel providing service, startup, and quality control field labor for the project from their local office.

1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out and start up.

2. Training: Provide technical representative to train Owner's maintenance personnel in operation and maintenance of specified equipment

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. Refer to above submittal requirements. The following abbreviations are used to indentify submittals required:

1. PD- Product Data

2. SD- Shop drawings

3. OM- Operation and Maintenance manual

4. T- Training of owners personnel on specific equipment items.

C. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical requirements, wiring diagrams, and provided accessories.

1. Restrict submitted material to pertinent data. For instance, do not include manufacturer's complete catalog when pertinent information is contained on a single page.

D. Shop drawings and schematics detailing fabrication, installation, piping layout, materials and finishes, system interconnections, and utility connections of equipment assemblies. Indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

1.5 INFORMATION SUBMITTALS

A. Factory tests and inspection reports prior to shipping.

B. Field test and start-up reports, indicating and interpreting test results relative to compliance with specified requirements, for information.

C. Certificates: For certification required in "Quality Assurance" Article

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For the equipment identified to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS

1.7 MAINTENANCE MATERIAL SUBMITTALS

B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set(s) for each belt-driven unit

C. Filters: one set for each unit containing a filter

1.8 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, function and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough, or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.

D. All parts shall be readily available locally in the United States.

E. Any units or parts which prove defective during the warranty period will be replaced with OEM parts and transportation prepaid.

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid, dusty conditions. Equipment shall be stored per manufacturer's recommendation.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Mark Number of this specification.

C. Provide equipment and materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

1.10 LABELING

A. Nameplate: Manufacturer shall securely attach in a prominent location on each major item of equipment a non-corrosive nameplate with stamped figures showing manufacturer's name, address, model number, serial number and pertinent utility or operating data.

B. Lifting capacity shall be painted with letters and numbers 3 inches high Minimum on both sides of lifting mast assembly.

A. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (U.L.), or other National Recognized Testing Laboratory (NRTL), in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant.

PART 2 – PRODUCTS

2.1 SHELVING UNIT
Equipment Mark Number: 1040

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Equipto.

B. Capacities and Dimensions:

1. Minimum number of openings: 66.

2. Minimum opening sizes:

a. 6 wide by 7-1/2 inches high: 60 each.

b. 6 wide by 9 inches high: 6 each.

3. Maximum overall dimensions:

a. Width: 36 inches.

b. Depth: 12 inches.

c. Height: 84 inches.

C. Features and Construction:

1. Unit uprights: Constructed of minimum 16 gauge steel with tapered slots on 1-1/2 inch centers for acceptance of shelf support brackets.

2. Shelves: Pan type with smooth edges, securely fastened at 10 points, constructed of minimum 18 gauge steel, adjustable on 1-1/2 inch centers.

3. Enclosure: Provided with side and back panels and base front strip.

4. Dividers: Laterally adjustable on 1 inch centers with quick-fastening clips.

5. Label holders: Full width 3/4 inch tab holder across each shelf.

6. End unit: Provide end unit(s) as required to close off row end.

a. Include (Add-On) units for long, continuous rows as needed. Each row to have end units for close-off

D. Finish: Durable enamel in Owner's choice of manufacturer's standard colors.

2.2 CABINET, 6 DRAWER
Equipment Mark Number: 1105

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Stanley Vidmar

B. General Description:

1. Metal shelf storage unit of workstation/bench height with multiple pull out shelves of various depths.

C. Capacities and Dimensions:

1. Maximum overall dimensions, nominal:

a. Width: 30 inches.

b. Depth: 27-3/4 inches.

c. Height: 33 inches.

2. Minimum quantity of drawers: 6.

3. Minimum drawer capacity: 400 pounds each.

4. Minimum drawer dimensions:

   a. Drawer usable height (Drawers numbered top to bottom):

      1) Drawers 1, and 2: 2-1/4 inches.

      2) Drawer 3: 3 inches.

      3) Drawers 4 and 5: 3-7/8 inches.

      4) Drawer 6: 7 inches.

5. Partition configurations:

   a. Drawer 1: 24 compartments.

   b. Drawer 2: 20 compartments.

   c. Drawer 3: 16 compartments.

   d. Drawer 4: 20 compartments.

   e. Drawer 5: 16 compartments.

   f. Drawer 6: 12 compartments.

D. Features and Construction:

1. Cabinet: Heavy gauge sheet steel cabinet shall be channel formed with mountings permitting installation of various height drawers, front columns with drilled and tapped bolt holes. Cabinet shall come complete with a keyed lock capable of securing all drawers within unit.

2. Base: Design of base shall include front and rear forklift openings of ample strength to permit moving of fully loaded cabinet. Front base plate shall be provided to prevent dirt buildup. Base shall be drilled for bolting to floor.

3. Drawer suspension: Cabinet shall be designed for total interchangeability for all drawer heights. Sealed steel roller bearing system shall permit full drawer extension at rated capacity without sagging.

4. Drawer walls: Slotted walls on 3/4 inch centers shall be provided for mounting dividers and partitions.

5. Drawer pulls: Drawer faces shall be fitted with nominal 3/4 drawer width drawer pulls with 1 inch high label holder provided with paper labels and protective vinyl shields and end caps.

6. Drawer dividers: All drawer dividers shall be factory installed.

7. Drawer heights: For adaptability to changing inventory needs drawers shall be available in usable heights of 2-1/4 to 13-1/4 inches in not over 1 inch increments.

E. Accessories:

1. Recessed base: Stanley Vidmar No. RB-1, one each.

2. Floor attachment kit: Stanley Vidmar No. CAK-1, one each.

F. Finish: Phosphate primer covered by durable enamel in Owner's choice of manufacturer's standard colors

2.3 CABINET, 9 DRAWER
Equipment Mark Number: 1113

G. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Stanley Vidmar

B. General Description:

1. Metal shelf storage unit of eye level height with multiple pull out shelves of various depths.

C. Capacities and Dimensions:

1. Maximum overall dimensions, nominal:

a. Width: 30 inches.

b. Depth: 27-3/4 inches.

c. Height: 59 inches.

2. Minimum quantity of drawers: 9.

3. Minimum drawer capacity: 400 pounds each.

4. Minimum drawer dimensions:

a. Drawer usable height (Drawers numbered top to bottom):

1) Drawers 1, 2, 3 and 4: 3-7/8 inches.

2) Drawers 5, 6, 7 and 8: 5-3/8 inches.

3) Drawer 9: 8-1/2 inches.

5. Partition configurations:

a. Drawer 1: 24 compartments.

b. Drawer 2: 20 compartments.

c. Drawer 3: 16 compartments.

d. Drawer 4: 12 compartments.

e. Drawer 5: 20 compartments.

f. Drawer 6: 16 compartments.

g. Drawer 7: 12 compartments.

h. Drawer 8: 8 compartments.

i. Drawer 9: 12 compartments.

D. Features and Construction:

1. Cabinet: Heavy gauge sheet steel cabinet shall be channel formed with mountings permitting installation of various height drawers, front columns with drilled and tapped bolt holes. Cabinet shall come complete with a keyed lock capable of securing all drawers within unit.

2. Base: Design of base shall include front and rear forklift openings of ample strength to permit moving of fully loaded cabinet. Front base plate shall be provided to prevent dirt buildup. Base shall be drilled for bolting to floor.

3. Drawer suspension: Cabinet shall be designed for total interchangeability for all drawer heights. Sealed steel roller bearing system shall permit full drawer extension at rated capacity without sagging.

4. Drawer walls: Slotted walls on 3/4 inch centers shall be provided for mounting dividers and partitions.

5. Drawer pulls: Drawer faces shall be fitted with nominal 3/4 drawer width drawer pulls with 1 inch high label holder provided with paper labels and protective vinyl shields and end caps.

6. Drawer dividers: All drawer dividers shall be factory installed.

7. Drawer heights: For adaptability to changing inventory needs drawers shall be available in usable heights of 2-1/4 to 13-1/4 inches in not over 1 inch increments.

E. Accessories:

1. Overhead cabinet: Stanley Vidmar No. OS-135, one each.

2. Adjustable shelf: Stanley Vidmar No. CS-40, one each.

3. Floor attachment kit: Stanley Vidmar No. CAK-1, one each.

F. Finish: Phosphate primer covered by durable enamel in Owner's choice of manufacturer's standard colors.

2.4 CABINET, PAINT AND INK
Equipment Mark Number: 1140

H. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Stanley Vidmar

B. Capacities and Dimensions:

1. Minimum storage capacity: 40 gallons.

2. Maximum overall dimensions, nominal:

a. Width: 43 inches.

b. Depth: 18 inches.

c. Height: 44 inches.

C. Features and Construction:

1. Standards: The cabinet shall comply with the latest requirements of NFPA combustible liquids Code No. 30 and OSHA safety requirements for the storage of paint and ink. Cabinet shall be FM approved.

2. Walls, top, bottom, and doors: Construction shall consist of double wall 18 gauge sheet steel with 1-1/2 inch air space between inner and outer walls.

3. Containment: Cabinet shall have a 2 inch pan-type bottom.

4. Fire baffle and cap

5. Screened flame arrester vent: Two vents per cabinet, one each at left side bottom and right side top, shall be threaded for and provided with 2 inch NPT steel plugs.

6. Closure: Double doors with full-length piano hinges and 3-point latch mechanism with key lock.

7. Shelf: Three each adjustable shelves shall be provided 14-3/4” apart.

D. Finish: High-gloss yellow epoxy powder finish inside and out with "FLAMMABLE - KEEP FIRE AWAY" in minimum 4 inch bright red letters across doors.

2.5 CABINET SHOP
Equipment Mark Number: 1185

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Equipto

B. Capacities and Dimensions:

1. Shelving: Full width shelves, five each.

2. Minimum shelf capacity: 200 pounds, minimum.

3. Maximum overall dimensions:

a. Width: 36 inches.

b. Depth: 18 inches.

c. Height: 78 inches.

C. Features and Construction:

1. Shelves: Four box edge full-length shelves shall be adjustable on maximum 2 inch centers without removing fasteners.

2. Doors: Three point box edge latching doors shall have common locks and two keys for each cabinet. Doors shall open a full 180 degrees and be flush mounted when closed with latching actuated by grip-type satin chrome plated steel handle.

3. Base: Cabinet shall be pedestal mounted for protection from moisture.

4. Assembly: Back, front, and sides shall be flush with no bolt heads on front or sides.

5. Locks: All cabinets covered by this specification shall be keyed alike.

D. Finish: Durable enamel in Owner's choice of manufacturer's standard colors.

2.6 DESK, STAND-UP
Equipment Mark Number: 1220

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Pucel

B. Capacities and Dimensions:

1. Overall desk dimensions:

a. Width: 36 inches.

b. Depth: 30 inches.

c. Height: 43 inches.

2. Drawer dimensions:

a. Width: 18 inches.

b. Depth: 27.5 inches.

c. Height: 5 inches.

C. Features and Construction:

1. Steel construction, with edges properly finished to prevent injury.

2. Cabinet area beneath drawer to have bottom, and intermediate shelf.

3. Writing surface to be sloped slightly.

4. Drawer to have telescoping ball bearing steel slides and have rolled handle and built-in key lock.

5. Provide with locking casters and pigeon hole units and risers.

D. Finish: Durable enamel in manufacturer's standard color.

2.7 COMPUTER CART
Equipment Mark Number: 1250

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by L.K Goodwin Company

B. Capacities and Dimensions:

1. Overall dimensions:

a. Width: 27 inches.

b. Depth: 24 1/2 inches.

c. Height: 50 inches.

C. Features and Construction:

1. Steel construction, with edges properly finished to prevent injury.

2. Mobil cabinet with room to fit a monitor, keyboard, and CPU.

3. Bottom shelf to be enclosed and lockable.

4. Solid back and internal cable routing.

5. Pull out keyboard tray.

6. Provide with locking casters.

D. Finish: Durable enamel in manufacturer's standard color.

2.8 LADDER, SAFETY
Equipment Mark Number: 1305

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Ladder Man

B. Capacities and Dimensions:

1. Steps: 4.

2. Step width: 24 inches

3. Overall dimensions (with handrails):

a. Width: 30 inches.

b. Depth: 45 inches.

c. Height: 73 inches.

4. Platform height: 40 inches

5. Casters:

a. Diameter: 2 inches.

b. Quantity: 4.

6. Handrail: 30 inch

C. Features and Construction:

1. Construction: Unit shall be welded steel tubing.

2. Casters: Unit shall have swivel castors in front and rigid castors in back. Casters shall be locking spring loaded ball bearing type.

3. Safety steps: Safety grating self-cleaning steps shall be constructed of expanded steel.

4. Feet: Rubber tipped feet with automatic positive step locking system shall be provided.

5. Handrails: Handrails shall be provided on both sides of steps and around top platform.

6. Compliance: Design shall comply with applicable OSHA safety standards.

D. Finish: Baked-on powder coat in manufacturer's standard color.

2.9 LADDER, SAFETY
Equipment Mark Number: 1310

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Ladder Man

B. Capacities and Dimensions:

1. Steps: 14.

2. Step width: 24 inches

3. Minimum Capacity: 350 pounds.

4. Overall dimensions (with handrails):

a. Width: 40 inches.

b. Depth: 108 inches.

c. Height: 183 inches.

5. Platform height: 140 inches

6. Casters:

a. Front: 2-4” swivel

b. Center: 2-6” rigid

c. Back- 2-4” rigid.

7. Handrails: 42 inch

C. Features and Construction:

1. Construction: Unit shall be welded steel tubing.

2. Casters: Unit shall have swivel castors in front and rigid castors in back and center. Casters shall be locking spring loaded ball bearing type. Ladder to lock into place when and individual steps on the first step triggering the release bar. The caster carriage retracts allowing the metal reinforced rubber-tipped feet to grip the floor. Ladder releases when the individual steps on a U-tube bar

3. Safety steps: Safety grating self-cleaning steps shall be constructed of expanded steel.

4. Feet: Rubber tipped feet with automatic positive step locking system shall be provided.

5. Handrails: Handrails shall be provided on both sides of steps and around top platform.

6. Compliance: Design shall comply with applicable OSHA safety standards.

7. Provide custom unit with side access from platform to the bus. Intent is for personal to access the roof of the bus from the side and not at the end.

D. Finish: Baked-on powder coat in manufacturer’s standard color.

2.10 RACK, GLASS
Equipment Mark Number: 1500

A. Manufacturers

1. Basis-of-Design Product: Custom fabricated item as shown

B. Capacities and Dimensions:

1. Minimum Capacity:

a. Lower compartments: 400 pounds each.

b. Upper compartments: 100 pounds each.

2. Minimum overall dimensions:

a. Width: 118-3/4 inches.

b. Depth: 61-1/2 inches.

c. Height: 94 inches.

C. Features and Construction:

1. Construction: Rack shall be fabricated per specification and as shown.

2. Materials:

a. All wood, including plywood, lumber, and all other wood products, to be fire-retardant treated wood per ICC IBC section 2303.2

b. Frame and base: Rack frame and base shall be constructed of No. 2 or better Douglas Fir.

c. Dividers and panels: Rack dividers and panels shall be constructed of 3/4 inch, five ply, BB or better plywood with smoothest surfaces facing up or out.

d. Exposed edges: All front facing exposed plywood edges shall be covered with hardwood nosing.

e. Wood framing in contact with floor shall be pressure treated.

3. Fastening: All joints shall be securely glued and fastened with countersunk wood screws.

4. Rack base: Base shall be slotted to permit entry of lift truck forks.

D. Finish: Paint exposed wood surfaces with two coats of semi-gloss enamel in Owner's choice of color.

2.11 RACK, PALLET
Equipment Mark Number: 1530

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Lyon Workspace Products

B. Capacities and Dimensions:

1. Uprights:

   a. Minimum Capacity: 22,000 pounds.

   b. Dimensions:

      1) Thickness: 3 inches.

      2) Depth: 42 inches.

      3) Height: 120 inches.

2. Beams:

   a. Minimum capacity: 6000 pounds per pair of beams.

   b. Dimensions:

      1) Length: 108 inches.

      2) Depth: 4-1/2 inches.

      3) Thickness: 2-3/4 inches.

   c. Installed top of beam height from finished floor (Verify beam heights with Owner prior to installation):

      1) First beams: 48 inches.

      2) Second beams: 84 inches.

      3) Top beams: 120 inches.

3. Minimum overall dimensions:

   a. Width: 114 inches.

   b. Depth: 42 inches.

   c. Height: 120 inches.

C. Features and Construction:

1. Uprights:

   a. Construction: Upright frames shall be continuously arc welded, heavy gauge steel box section uprights with deep channel cross and diagonal members.

b. Adjustment: Tapered keyhole slots shall be punched on 2 inch centers on both sides for vertical beam adjustments.

c. Base plate: Heavy gauge steel plates with holes for anchoring to floor shall be arc welded to uprights.

2. Beams:

a. Construction: Beams shall be welded, step-type heavy gauge steel box channel.

b. Attachment: Three high tensile studs shall be provided on each end to engage tapered keyhole slots in uprights, locking flush by means of spring loaded lock snaps.

D. Accessories: 52 inches wide by 42 inches deep wire decking with required support channels, Lyon No. WD5242H, two per shelf.

E. Finish: Durable enamel in Owner's choice of manufacturer's standard colors.

2.12 RACK, TIRE
Equipment Mark Number: 1640

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by BCW Engineering and Manufacturing

B. Capacities and Dimensions:

1. Minimum rack capacity: 4,000 pounds.

2. Minimum overall dimensions:

a. Length: 16 feet.

b. Width: 33 inches.

c. Height: 96 inches.

3. Two Tier

C. Features and Construction:

1. Design: Designed for storing mounted and unmounted single and dual wheel bus and the truck tires

2. Construction: Rack posts and braces shall be fabricated of heavy wall tubular steel and pipe. All joints shall be continuous welded.

3. Gussets: Posts shall be reinforced with continuously welded gussets at side braces and at front and rear braces.

4. Provide with 1 ton jib crane trolley

5. Meet OSHA standards

6. Anchored base pads

D. Finish: Durable enamel in manufacturer's standard color.

2.11 SHELVING UNIT, 18 INCH
Equipment Mark Number: 1680

B. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Equipto

B. Capacities and Dimensions:

1. Number of shelves: Seven total.

2. Minimum shelf capacity: 1000 pounds per shelf.

3. Maximum overall dimensions, nominal:

a. Width: 36 inches.

b. Depth: 18 inches.

c. Height: 84 inches.

4. Installed shelf height from finished floor, nominal:

a. Top shelf: 84 inches.

b. Bottom shelf: 1 inch.

c. Remaining shelves: Evenly spaced, approximately 12 inches center to center.

C. Features and Construction:

1. Shelf construction: Shelves shall be constructed of 18 gauge steel with double flanged, box-formed edges on all four sides and front and rear shelf edge reinforcing channels.

2. Uprights: Uprights shall be double flanged with tapered bracket slots punched on 1-1/2 inch centers for vertical shelf adjustment.

3. Shelf securement: Slip-in shelf brackets shall reinforce and securely lock shelf into place on all four corners.

4. Commonality: Units shall have the capability of sharing common end and back panels with adjoining units.

5. Assembly: Unit shall be designed for complete, rigid assembly and adjustment without tools.

D. Finish: Durable enamel in Owner's choice of manufacturer's standard colors.

2.12 AUTOMATED CABINET, MATERIALS STORAGE
Equipment Mark Number: 1725

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Remstar International, Inc.

B. General Description:

1. A self contained, high density cabinet consisting of shelves and bins with an automated, mechanized retrieval system and controls. The unit shall be capable of loading and retrieving various sizes and weights of trays and bins, and shall be capable of being re-configured by the end-user.

C. Capacity and Dimensions:

1. Maximum overall dimensions, nominal

a. Depth: 122 inches

b. Width: 86 inches

c. Height: 216 inches

2. Tray quantity: 50 light capacity trays

3. Shelf rail quantity: 160

Usable tray size:

a. Width: 72 inches.

b. Depth: 34 inches.

4. Load capacity:

a. Minimum load per light tray: 772 pounds.

b. Minimum load per medium tray: 1146 pounds.

c. Minimum load per heavy tray: 1100 pounds.

5. Maximum shuttle weight: 5304 pounds

6. Maximum tray weight: 3100 pounds

7. Maximum weight with empty trays: 8400 pounds

8. Maximum weight with fully loaded trays: 47,000 pounds

9. Maximum lifting speed: 150 feet per minute.

10. Maximum access time: 38.77 seconds

D. Features and Construction:

1. The unit shall be equipped with double tray access to allow the operator to have the system automatically retrieve the next desired tray and deliver it at the operators command.

2. The system will come complete with lockable safety shutter security doors.

3. The unit shall be ESD protected.

4. The system shall be provided with a locking tray hold for loading and unloading of individual trays.

5. Variable extraction speeds shall be provided with a minimum of 1.8 inches per second to a maximum of 16.5 inches per second. Extracting speed can be set on each tray based upon product stored.

6. The integrated software shall provide advanced levels of inventory control, kitting, order picking, light directed picking, managerial reports, and control of multiple units to be directly integrated with customers host software system.

7. Provide with tooth belt drive

8. Hinged access door on side of unit for emergency maintenance.

9. Internal weight management system that monitors tray and unit capacity to eliminate operator error.

10. Coordinate tray spacing with owner.

11. OSHA approved design

E. Controls:

1. The control package shall be designed to allow customized operation of all controls by the user and allow full control of horizontal and vertical speeds. The four operating modes are:

a. Fixed – each tray has a designated position within the unit.

b. Optimized – each tray is measured for height and stored in the unit to maximize density.

c. Mixed-selection of the tray according to it's 'fixed' or 'optimized' status.

d. Fixed height mixed – A maximum height may be assigned to each tray to prevent it from being placed in an area that would use more space that needed.

2. Controls to be mounted inside overhead center

3. All information in plain text, not coded information in multiple languages.

4. Large LCD display with color graphic design feature, background illumination, high contrast, low glare, and easy reading.

5. Easy tray storage and retrieval functions using numeric keyboard and control keys.

6. Discrete tray speed settings allow one unit to store both sensitive and non-sensitive items.

F. Utilities Available: 460 VAC, 3 phase, 15 amps and 120VAC, 1 phase

G. Finish: Manufacturer's standard finish

2.13 TABLE, LAYOUT, STAINLESS STEEL TOP
Equipment Mark Number: 1765

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Bench Depot

B. Capacities and Dimensions:

1. Minimum capacity: 5000 pounds.

2. Overall dimensions:

a. Width: 117 inches.

b. Depth: 36 inches.

c. Height: 30 to 36 inches.

C. Features and Construction: Bench to be constructed of 16-gauge 3-inch square tube legs, 16-gauge 2-inch by 3-inch rectangular tube frame, and 18 gauge, grade 304 stainless steel top over 1-1/8” particle board core. The steel top shall be constructed of grade 304 steel with a brushed #4 finish and shall have a sealed bottom.

D. Accessories:

1. Adjustable legs: Set of four, zinc-plated, 6-inch adjustable legs with nickel-plated glides, model LZ, one each.

2. Footrest for added stability

E. Finish: Durable enamel in Owner's choice of manufacturer's standard colors.

2.14 TABLE, LAYOUT, WOOD TOP
Equipment Mark Number: 1776

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Bench Depot

B. Capacities and Dimensions:

1. Minimum capacity: 5000 pounds.

2. Overall dimensions:

a. Width: 120 inches.

b. Depth: 36 inches.

c. Height: 30 to 36 inches.

C. Features and Construction: Bench to be constructed of 16-gauge 3-inch square tube legs, 16-gauge 2-inch by 3-inch rectangular tube frame, and 1-1/2-inch thick solid maple butcherblock made from oil treated solid maple hardwood with round edges. Wood to be dried in a low atmosphere for one year.

D. Accessories:

1. Adjustable legs: Set of four, zinc-plated, 6-inch adjustable legs with nickel-plated glides, model LZ, one each.

2. Locking casters: Set of four, 1200 pound capacity, 5-inch diameter, urethane casters, model DL5-U, one each.

3. Footrest for added stability.

E. Finish: Durable enamel in Owner's choice of manufacturer's standard colors.

2.15 WORKBENCH, SEVERE USE
Equipment Mark Number: 1860

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Service Scaffold

B. Capacities and Dimensions:

1. Minimum capacity: 2,500 pounds.

2. Work surface thickness: 3/8 inch.

3. Overall dimensions:

a. Width: 72 inches.

b. Depth: 32 inches.

c. Height: 34 inches.

C. Features and Construction:

1. Construction:

a. Legs: Workbench legs shall be fabricated of 3 by 3 by 1/4 inch steel angle.

b. Leg braces: Leg braces shall be 3 by 3 by 1/4 inch angle steel with continuous electrical welds to tubing as shown.

c. Top braces: Top braces shall be 3 by 3 by 1/4 inch angle steel with continuous electrical welds to tubing as shown.

d. Top: Top shall be 3/8 inch plate steel with 50 percent minimum electrical welds to top braces. Corners of top shall have 2 inch radius for protection of personnel. All edges shall be ground smooth.

e. Welds: All welds shall conform to American Welding Society standards.

f. Two steel shelves

D. Finish: Cover all exposed steel surfaces including both sides of top, braces, and legs with one coat zinc chromate primer and two coats epoxy paint in Owner's choice of colors.

2.16 BENCH, BATTERY
Equipment Mark Number: 2030

A. Manufacturers

1. Basis-of-Design Product: Custom fabricated item as shown

B. Capacities and Dimensions:

1. Minimum capacity: 200 pounds per linear foot of bench.

2. Overall dimensions, nominal:

a. Length: As shown.

b. Depth: 24 inches.

c. Height: 20 inches.

3. Dry paint thickness, minimum: 6 mils.

C. Features and Construction:

1. Construction: Bench shall be fabricated per specification and as shown.

2. Materials: Unit materials shall be 2 by 4 inch Grade 1 or better hardwood, smooth, straight, kiln dried oak, marine grade wood glue, and zinc plated, No. 12 by 2-3/4 inch flat head wood screws.

3. Wood framing in contact with floor shall be pressure treated.

4. Assembly: All joints shall be glued and fastened with countersunk wood screws.

D. Finish: All exposed wood surfaces shall be sealed and finished with 1 to 1 mix of International Paint Integard-740 epoxy paint product number and curing agent number 4346-B applied per manufacturer's recommendations in Owner's choice of color.

2.17 CART, PARTS
Equipment Mark Number: 5030

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Pucel Enterprise

B. Capacities and Dimensions:

1. Minimum capacity: 3000 pounds.

2. Length: 48 inches.

3. Width: 24 inches.

4. Height: 32 ½ inches

5. Quantity of shelves: 3

C. Features and Construction:

1. Construction: Rigid unit shall be all welded 12 gauge steel construction. Supporting posts shall be 1-3/4 by 1-3/4 by 3/16 inch angle steel with shelves and tubular push handle welded to post frame.

2. Casters: Cart shall be equipped with two swivel and two fixed phenolic locking castors.

3. Shelves: Top shelf shall be flat. Middle and bottom shelves shall be tray shelves, 2 inches deep.

D. Finish: Durable enamel in manufacturer's standard color.

2.18 DOLLY, DRUM, 600 POUND
Equipment Mark Number: 5290

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Hamilton Caster and Manufacturing Company.

B. Capacities and Dimensions:

1. Inside diameter: 23-1/2 inches.

2. Height: 3-1/2 inches.

3. Minimum capacity: 600 pounds.

4. Wheels:

a. Quantity: Four each.

5. Frame:

a. Thickness: 3/16 inch.

b. Width: 3 inches.

C. Features and Construction:

1. Frame: Criss-cross frame shall be constructed of welded steel members.

2. Drum lips: Ends of frame shall be turned up to retain loads.

3. Capacity: Dolly shall be designed to accommodate 55-gallon drums.

4. Wheels: Ball bearing swivel casters shall be of oil resistant synthetic plastic.

D. Finish: Durable enamel in manufacturer's standard color.

2.19 HOPPER, SELF DUMPING, 3/4 YARD
Equipment Mark Number: 5460

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Roura Iron Works, Inc

B. Capacities and Dimensions:

1. Minimum hopper capacity: 3/4 cubic yard, 8000 pounds.

2. Caster wheel diameter: 8 inch.

3. Caster wheel width: 2 inch.

4. Minimum overall dimensions:

a. Length: 60-1/2 inches.

b. Width: 39-1/2 inches.

c. Height: 36 inches (44” with casters)

C. Features and Construction:

1. Construction: Hopper shall be fabricated of 3/16 inch arc welded plate steel, braced and double braced at stress points with steel angle.

2. Base: Hopper base shall accommodate forklift handling. Opening: 2-1/2” x 29-1/2”

3. 1/4” rocker plate with riveted rocker angle

4. Angle reinforced top and front

5. Casters: Four each polyolefin casters shall be mounted securely to base, two fixed, two swivel, Roura No. 8-PO.

6. Operation: Mechanical hopper release catch pulley system shall release and then automatically lock without operator having to touch hopper.

D. Finish: Durable enamel. Color selected by owner.

2.20 BUS TIRE CAROUSEL
Equipment Mark Number: 8121

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Vidir

B. Capacities and Dimensions

1. Maximum tire diameter: 44 inches

2. Minimum tire quantity: 78 tires based on 11” width tires

3. Carrier quantity: 6

4. Motor: (x2) 2 Hp

5. Minimum per carrier weight capacity: 2,000 pounds

6. Minimum machine capacity: 13,000 pounds

7. Minimum off balance load capacity: 2,500 pounds

8. Maximum overall dimensions:

a. Height: 211 inches

b. Width: 178 ½ inches

c. Depth: 111 ½ inches

C. Features and Construction

1. Description: Vertical tire carousel, motor driven, operated by a single user.

2. Full enclosure with solid paneling on the front and rear in addition to an enclosed ceiling.

3. cCSAus certified

4. All steel construction engineered to withstand the specified loading requirements.

5. Assembly to be factory fabricated and tested.

6. Designed to be bolted to the floor.

D. Controls

1. Forward/reverse push button controls with security keypad- front right location

E. Accessories

1. Variable frequency drive: Provides the operator variable speed operation during carousel operation.

2. Tire ramp: Assist the operator in loading and unloading the carousel. Ramps designed to eliminate the requirement to manually lift tires on and off the carousel by creating an incline for tires to roll in/out of position.

F. Utilities Available

1. Electrical: 208 V 3 phase, 15 Amp

G. Finish

1. Durable enamel in manufacturer's standard color.

2.21 PARATRANSIT TIRE CAROUSEL
Equipment Mark Number: 8122

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Vidir

B. Capacities and Dimensions

1. Maximum tire diameter: 32 inches

2. Minimum tire quantity: 153 tires based on 9” width tires

3. Carrier quantity: 9

4. Motor: (x2) 1.5 Hp

5. Minimum per carrier weight capacity: 1,000 pounds

6. Minimum machine capacity: 13,000 pounds

7. Minimum off balance load capacity: 1,800 pounds

8. Minimum overall dimensions:

a. Height: 214 inches

b. Width: 177 inches

c. Depth: 92 ½ inches

C. Features and Construction

1. Description: Vertical tire carousel, motor driven, operated by a single user.

2. Full enclosure with solid paneling on the front and rear in addition to an enclosed ceiling.

3. cCSAus certified

4. All steel construction engineered to withstand the specified loading requirements.

5. Assembly to be factory fabricated and tested.

6. Designed to be bolted to the floor.

D. Controls

1. Forward/reverse push button controls with security keypad- front right location

E. Accessories

1. Variable frequency drive: Provides the operator variable speed operation during carousel operation.

2. Tire ramp: Assist the operator in loading and unloading the carousel. Ramps designed to eliminate the requirement to manually lift tires on and off the carousel by creating an incline for tires to roll in/out of position.

F. Utilities Available

1. Electrical: 208 V 3 phase, 15 Amp

G. Finish

1. Durable enamel in manufacturer's standard color

PART 3 - EXECUTION

3.1 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match and/or non-interference with equipment to be installed.

B. Inspect delivered equipment for damage from shipping and exposure to weather.

C. Compare delivered equipment with packing lists and specifications to assure receipt of all items.

3.2 INSTALLATION

A. Perform work under direct supervision of Foreman or Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect.

Install equipment in accordance with plans, shop drawings, and manufacturer's instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level, plumb and at right angles to adjacent work.

2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.

3. Anchorage: Attach equipment securely to floor, per manufacturer's instructions and as directed by Architect, to prevent damage resulting from inadequate fastening. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.

4. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.3 TESTING

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to start-up inspect, test, and adjust components, assemblies, and equipment installations, including connections, check operation of the equipment and components for operation and performance as specified and examine the finish for damage. Provide report in writing that the installation meets the requirements and shall include information concerning minor adjustments and minor repairs, which may be required before final acceptance by the Owner.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment

B. Prepare test and inspection reports

C. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with all specified features in the presence of the Architect using acceptance procedures provided by the manufacturer.

3.4 CLEANUP

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing or installation debris from job site.

D. Notify Architect for acceptance inspection.

3.5 TRAINING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment.

B. Direct the technical representative to provide specified hours of training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.

1. CABINET, MATERIALS STORAGE, AUTOMATED
   Equipment Mark Number: 1725
   Hours Required: 2

2. BUS TIRE CAROUSEL
   Equipment Mark Number: 8121
   Hours Required: 2

3. PARATRANSIT TIRE CAROUSEL
   Equipment Mark Number: 8122
   Hours Required: 2

C. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

D. Provide a Windows compatible movie file format recording on DVD disk of the training session. The DVD training movie can be of a live session or a produced training video.

END OF SECTION 106700

SECTION 107500 - FLAGPOLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes ground-mounted flagpoles made from aluminum.

B. Owner-Furnished Material: Flags.

C. Related Sections:

1. Section 265600 "Exterior Lighting" for site lighting fixtures.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand the effects of gravity loads, and the following loads and stresses within limits and under conditions indicated according to the following design criteria:

1. Seismic Loads: according to SEI/ASCE 7.

2. Wind Loads: according to NAAMM FP 1001, "Guide Specifications for Design of Metal Flagpoles."

3. Base flagpole design on polyester flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

C. Shop Drawings: For flagpoles. Include plans, elevations, details, and attachments to other work. Show general arrangement, jointing, fittings, accessories, grounding, anchoring, and support.

1. Include section, and details of foundation system for ground-mounted flagpoles.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Delegated-Design Submittal: For flagpole assemblies indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For flagpoles to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain each flagpole as complete unit, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. General: Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ace Flag Company
2. American Flagpole and Flag Company.
3. U.S. Flag & Flagpole Supply.

2.2 FLAGPOLES

A. Flagpole Construction, General: Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:

1. Fabricate shop and field joints without using fasteners, screw collars, or lead calking.

2. Provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.

3. Provide self-aligning, snug-fitting joints.

B. Exposed Height: 30 feet (9 m) and 35 feet (11 m).

C. Aluminum Flagpoles: Provide cone-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B 241/B 241M, Alloy 6063, with a minimum wall thickness of 3/16 inch (4.8 mm).

D. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, not less than 0.064-inch- (1.6-mm-) nominal wall thickness. Provide with 3/16-inch (4.8-mm) steel bottom plate and support plate; 3/4-inch- (19-mm-) diameter, steel ground spike; and steel centering wedges welded together. Galvanize steel after assembly. Provide loose hardwood wedges at top of foundation tube for plumbing pole.

1. Provide flashing collar of same material and finish as flagpole.

2.3 FITTINGS

A. Finial Ball: Manufacturer's standard flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.

1. 0.063-inch (1.6-mm) spun aluminum, finished to match flagpole.

B. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Provide flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

1. Halyard Flag Snaps: Provide two stainless-steel swivel snap hooks per halyard.

a. Provide with neoprene or vinyl covers.

2.4 MISCELLANEOUS MATERIALS

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107.

B. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.

C. Sand: ASTM C 33, fine aggregate.

D. Elastomeric Joint Sealant: Single-component nonsag urethane joint sealant complying with requirements in Section 079200 "Joint Sealants" for Use NT (nontraffic) and for Use M, G, A, and, as applicable to joint substrates indicated, for Use O.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including foundation; accurate placement, pattern, orientation of anchor bolts, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.

B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.

C. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.

D. Place concrete, as specified in Section 033000 "Cast-in-Place Concrete" Compact concrete in place by using vibrators. Moist-cure exposed concrete for not less than seven days or use nonstaining curing compound.

E. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.3 FLAGPOLE INSTALLATION

A. General: Install flagpoles where shown and according to Shop Drawings and manufacturer's written instructions.

B. Ground Set: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure. Install flagpole, plumb, in foundation tube.

1. Foundation Tube: Place tube seated on bottom plate between steel centering wedges and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch (50-mm) layer of elastomeric joint sealant and cover with flashing collar.

END OF SECTION 107500

SECTION 109900 – TACTILE WARNING SURFACE

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes replaceable tactile warning surface units.

1.2 REGULATORY REQUIREMENTS

A. Comply with the following:

1. Americans with Disabilities Act (ADA) Title 49 CFR Transportation, Part 37.9 Standards for Accessible Transportation Facilities, Appendix A, Section 4.29.2 Detectable Warnings on Walking Surfaces, ADA and ABA Accessibility Guidelines for Buildings and Facilities (7/23/04, amended 8/5/05): Sections 218, 405, 406, 705, and 810, Revised Draft Guidelines for Accessible Public Rights of Way (11/23/05): Sections R221, R303, R304, R305, R308, and R414.
2. American Society for Testing and Materials (ASTM) Test Methods B 117, C1028, D543, D570, D638, D695, D790, D1308, GI51, GI55, and E84.

1.3 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS .

B. Product Data: Submit manufacturer's literature describing products, installation procedures and maintenance instructions.

C. Samples for Verification Purposes: Submit two (2) tactile warning surface samples minimum 8" x 8" of the kind proposed for use, Samples shall be properly labeled and shall contain the following information: Name of Project, Submitted by, Date of Submittal, Manufacturer's Name, and Catalog No.

D. Shop Drawings: Submit Standard Manufacturer Shop Drawings showing all pertinent characteristics of the tactile warning surface unit including profile, sound on cane contact amplification feature and installation methods.

E. Material Test Reports: Submit current test reports from qualified independent testing laboratory in accordance with ASTM guidelines and indicating that materials proposed for use are in compliance with specification requirements and meet the properties indicated. All test reports submitted shall be representative of the tactile warning surface product delivered to the Project, and shall be no more than three (3) years old from the time of the submittal.

1.4 CLOSEOUT SUBMITTALS

A. Warranty: For Tactile Warning Surfaces specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 QUALITY ASSURANCE

A. Provide tactile warning surface units and accessories as produced by a single manufacturer.

B. Installer's Qualifications: Engage an experienced installer certified in writing by the tactile warning surface manufacturer, who has successfully completed tactile warning surface installations similar in material, design, and extent to that indicated for the Contract.

C. Tactile warning surface product shall meet or exceed the following test criteria using the most current test methods:

1. Water Absorption: Not to exceed 0.20%, when tested in accordance with ASTM-D570.
2. Slip Resistance: 0.80 minimum combined wet/dry static coefficient of friction when tested in accordance with ASTM C 1028.
3. Compressive Strength: 25,000 psi minimum, when tested in accordance with ASTM D695.
4. Tensile Strength: 10,000 psi minimum, when tested in accordance with ASTM D638.
5. Flexural Strength: 25,000 psi minimum, when tested in accordance with ASTM D790.
6. Chemical Stain Resistance: No reaction to 1% hydrochloric acid, motor oil, calcium chloride, gum, soap solution, bleach, and antifreeze, when tested in accordance with ASTM D543 or D 1308.
7. Abrasion Resistance: 300 minimum, when tested m accordance with ASTM C501.
8. Flame Spread: 25 maximum, when tested in accordance with ASTM E84.
9. Accelerated Weathering of Tactile Warning Surface when tested by ASTM-GI55 or ASTM G 15 I shall exhibit the following result: $\Delta E<5.0$ at 2,000 hours minimum exposure.
10. AASHTO-H20 Load Bearing Test: No Damage at 16,000# loading.
11. Salt and Spray Performance of Tactile Warning Surface: No deterioration or other defects after 200 hours of exposure, when tested in accordance with ASTM-BI17.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Tactile warning surface units shall be suitably packaged or crated to prevent damage in shipment or handling. Finished surfaces shall be protected by sturdy wrappings.

1.7 WARRANTY

A. Manufacturer’s Warranty: Manufacturers standard form in which manufacturer agrees to repair or replace defective work, breakage, deformation, and loosening of tactile warning surface material. The manufacturer shall also warrant and certify that the reverse profile of the unit will not change in any way for a minimum of 10 years to insure full product interchangeability.

1. Warranty Period: Five years from date of substantial completion.

PART 2 - PRODUCTS

2.1 PRODUCT

1. Basis-of-Design Product: Subject to compliance with requirements, provide Replaceable Composite (wet-set) Tactile; ADA Solutions, Inc.

B. the following:

1. Replaceable Composite (wet-set) Tactile

C. Tactile warning surface units shall be manufactured using a matte finish exterior grade homogeneous (uniform throughout thickness of product) glass and carbon reinforced polyester based SMC composite material. Truncated domes must contain fiberglass reinforcement within the truncated dome for superior structural integrity and impact resistance. A matte finish will be required on the tactile warning surface for superior slip resistance performance superior to that offered by a gloss finish. Use of tactile warning surface products employing coatings or featuring layers of material with differing composition, performance, or color properties is expressly prohibited under this Section.

D. Color: Color shall be homogeneous throughout the tactile warning surface unit.

1. Seattle Yellow (SY) per Federal Standard 595B Table IV, Color No. 23594.

E. Domes: Square grid pattern of raised truncated domes of 0.2 inches nominal height, base diameter of 0.9 inches, and top diameter of 0.45 inches. Truncated domes shall have a center-to-center (horizontally and vertically) spacing of 2.35 inches, measured between the most adjacent domes on square grid.

F. Configuration: Tactile warning surface units shall feature a minimum of four (4) embedded corrosion resistant 1.50” zinc inserts with 1/2” dia. Stainless Steel fasteners. Fasteners must be covered with a structural water tight cap. Fasteners must be located BETWEEN the truncated domes (in the field) for maximum protection of the fastener integrity. Fasteners are NOT to be located in the truncated dome.

1. The field area shall consist of a non-slip textured surface with a minimum static coefficient of friction of 0.80, wet and dry.
2. At a minimum, tactile warning surface product thickness shall measure 3/8” (nominal) exclusive of the perimeter 5/8” thick by 1" wide flange structure. The body of the unit must consist of a solid body for maximum strength and to eliminate the possibility of air entrapment and cracking. "Hollow back," "honeycomb," or "waffle tiles" are not acceptable for use on this Project.
3. Size: 24” wide x 48” long.

G. Cleaning materials used on site shall have code acceptable low VOC solvent content and low flammability.

2.2 EQUIPMENT

A. Contractor shall provide all tools, equipment and services required for satisfactory installation per manufacturer's instruction.

PART 3 - EXECUTION

3.1 PREPARATION

A. During all concrete placement and tactile warning surface product installation procedures, ensure adequate safety guidelines are in place and that they are in accordance with the applicable industry and government standards.

B. The physical characteristics of the concrete shall be consistent with the Contract Specifications while maintaining a slump range of 4 - 7 to permit solid placement of the tactile warning surface unit. An overly wet mix will cause the tactile warning surface unit to float. Under these conditions suitable weights such as 2 concrete blocks or sandbags (25 pounds) shall be placed on each tactile warning surface unit

C. The concrete shall be placed and finished, true and smooth to the required dimensions and slope prior to tactile warning surface unit placement

3.2 INSTALLATION

A. Tactile warning surface product shall be installed per manufacturer's instructions.

B. The tactile warning surface units shall be tamped or vibrated into the fresh concrete to ensure that there are no voids or air pockets, and the field level of the tactile warning surface unit is flush to the adjacent concrete surface or as the Drawings indicate to permit proper water drainage and eliminate tripping hazards between adjacent finishes.

C. As part of the concrete finishing operation, the Installer shall apply 1/4” edge treatment around the perimeter of the Tactile Warning Surface Units to facilitate future replacement of the Tactile Warning Surface Unit. A Urethane Sealant such as Sikaflex 1a or BASF Sonneborn NP 1 shall be applied to the edge treatment for a watertight Tactile Warning Surface Unit installation.

3.3 CLEANING AND PROTECTION

A. Protect tactile warning surface unit against damage during construction period to comply with tactile warning surface unit manufacturer's Specifications.

B. During and after the tactile warning surface unit installation and the concrete curing stage, it is imperative that there are no walking, leaning or external forces placed on the tactile warning surface unit to rock the tactile warning surface unit, causing a void between the underside of the tactile warning surface unit and the concrete substrate.

END OF SECTION 19900

SECTION 111400- FUEL AND FLUID MANAGEMENT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

The General Provisions of the Contract, including General and Special Conditions, apply to the Work in this Section.

1.2 WORK INCLUDED

A. Equipment items as listed below by Equipment Mark Number:

1. FUEL/FLUID MANAGEMENT SYSTEM, TRANSIT
Equipment Mark Number: 8210
Submittal requirements: PD, SD, OM, T

B. Roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.

1. Coordinate and verify all electrical and utility connections with all trades prior to equipment ordering and purchase.

C. Piping, wiring, and switching between equipment and utilities.

1.3 QUALITY ASSURANCE

A. Experience: Equipment shall be produced by a manufacturer of established reputation with a minimum of five years experience supplying specified equipment.

B. Fluid Management System Manufacturer shall provide the engineering, installation, calibration, software programming and check-out necessary to for a complete and fully operational fluid management system.

C. Each product shall be provided by a single manufacturer.

D. All components shall be fully tested and documented to operate as a complete system.

E. Manufacturer's Representative:

1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out and start up. The Fluid Management System installer is required to be a manufacturer certified installer for the system being installed. .

2. Training: Provide technical representative to train Owner's maintenance personnel in operation and maintenance of specified equipment.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

H. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. Refer to above submittal requirements. The following abbreviations are used to indentify submittals required:

1. PD- Product Data

2. SD- Shop drawings

3. OM- Operation and Maintenance manual

4. T- Training of owners personnel on specific equipment items

C. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical requirements, wiring diagrams, and provided accessories.

1. Submit Product Data in accordance with General Requirements of these specifications.

2. Restrict submitted material to pertinent data. For instance, do not include manufacturer's complete catalogue when pertinent information is contained on a single page.

1.5 INFORMATION SUBMITTALS

A. Shop drawings and schematics detailing fabrication, installation, piping layout, materials and finishes, system interconnections, and utility connections of equipment assemblies. Indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

B. Factory tests and inspection reports prior to shipping.

C. Field test and start-up reports, indicating and interpreting test results relative to compliance with specified requirements, for information.

D. Certificates: For certification required in "Quality Assurance" Article

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For the equipment identified to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, function and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough, or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.

D. All parts shall be readily available locally in the United States.

E. Any units or parts which prove defective during the warranty period will be replaced with OEM parts and transportation prepaid.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid, dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Mark Number of this specification.

C. Provide equipment and materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

1.9 LABELING

A. Manufacturer shall securely attach in a prominent location on each major item of equipment a non-corrosive nameplate showing manufacturer's name, address, model number, serial number, and pertinent utility or operating data.

B. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (U.L.), or other National Recognized Testing Laboratory (NRTL), in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant.

PART 2 – PRODUCTS

2.1 FUEL/FLUID MANAGEMENT SYSTEM, TRANSIT
Equipment Mark Number: 8210

A. System shall be FLEETWATCH System by S & A Systems, Inc., Rockwall, Texas, phone 972/722-1009.

B. General Description:

1. System parameters: In the basic configuration, the system shall record vehicle number, mileage and amounts of diesel fuel, engine oil (two types) , diesel exhaust fluid (DEF), transmission fluid (two types) and engine coolant (two types) dispensed to buses and unleaded gasoline dispensed to support vehicles at each service (fueling) position. Additionally, system shall record vehicle number and amounts of engine oil (two types), transmission fluid (two types) and engine coolant (two types) dispensed to vehicles in the Maintenance shop area. Additional system equipment shall provide electronic recording of vehicle number and mileage from buses equipped with electronic trip recorders as defined under special equipment in this specification. This system shall provide a fully functional interface to a tank-monitoring controller for monitoring of fluids stored in tanks, and fluid deliveries. The system shall provide software for fluid use and inventory reports. The system shall permit add-on expansion of additional liquid products, if desired by owner at a future date, as well as integration with like systems at other ConnDot facilities with interface capability to a remote central computer. This system shall be fully compatible with like systems at other facilities. The system shall automatically collect, record, transmit, compile and print data as specified herein.

2. System equipment: Equipment shall include but not be limited to the following:

a. Remote Island Head (RIH) Units and remote island head junction box: Located at each bus and support vehicle service positions (one RIH unit for each service position) and as required for control and monitoring of all oil, coolant and ATF reels in the Maintenance Shop area. Also include one spare RIH unit capable of operating in any service position. Refer to process drawings for RIH locations. Provide all required remote island head junction boxes and support stands.

b. SYSTEMController: Controller Server, with internal storage and communication capabilities to provide an interface with existing Information System/Vehicle Maintenance Software by means of direct connection or network interface

c. Fixed Receivers: Fixed Radio Frequency Receivers shall be located in each vehicle service position for capture of vehicle number and other data defined in this specification (see special equipment section for complete description)

d. Control valves and pulse generators not included in other specification sections or contract drawings that are required by Fluid Management System (FMS) shall be provided and installed by FMS. Locate as required per each service position and in the maintenance shop area

e. Vehicle Detectors, installed in each diesel fueling position, connected to RIH to automatically terminate transaction.

f. SYSTEM Monitor 3.5 and DataTools 3.0 Software and programs as necessary for functioning of RIH and SYSTEMController Unit.

Software shall verify accurate data transmission using reasonableness checks, parity checks, and other checks required to ensure accurate data transmission. Data in SYSTEMController Unit shall not be erased until accurate data transmission and storage verification is received from the host computer during a transmission session

g. Data Logger Vehicle-mounted equipment shall be furnished by the fluid management system manufacturer for automatic capture of vehicle number, mileage, engine hours and electronic engine data, for all of the owners busses. Data logger to be installed by owner. Manufacturer to provide training and instructions to assist in the installation.

C. System Operation:

1. FMS shall provide mileage, engine, hours, diesel fuel, gasoline, engine oil (two types), transmission fluid (two types), DEF and engine coolant (two types) record management by automatically recording, storing and compiling formatted transaction data continuously on a 24-hour per day basis

2. FMS shall be automatic except for operator functions specified herein. System shall operate unattended except for normal service operator inputs, operator file updates, periodic status monitoring, and printer paper and ribbon replacement. Operator transactions and printer messages shall be in conversational language. Input and output codes shall not be used, unless format and storage capacities absolutely dictate their use. All operator transactions and printer messages shall be defined in plain language and be bound in a system manual.

3. FMS shall verify all bus or vehicle identification inputs against bus and vehicle authorization file.

4. FMS shall verify all employee identification inputs against employee authorization file.

5. FMS shall utilize an HTML-based graphical user interface to provide SYSTEMController Server operator with ability to:

a. Set current date and time.

b. Delete vehicle authorization from file.

c. Enter vehicle authorization and vehicle definition parameters in file.

d. Enter employee authorization information in file.

e. Delete employee from file.

f. Place RIH units off and on line.

g. Set fluid quantity limits for exception reports.

h. Set engine oil type by vehicle for selective oil control.

i. Set request and schedule print option for each report.

j. Request Status of Fluid Storage tanks.

k. Request Record of Fluid Receipts.

l. Request Tank Alarm History.

m. Define Storage Tank Parameters.

n. Produce all reports defined in the System Reporting Requirements section of these specifications.

o. Define Maintenance Bay reel sets for Select Bay feature.

p. FMS shall provide the capability for all of the above data to be downloaded from a host CPU to the System Controller on demand from the host CPU

6. Sequence of Operations – Diesel and Unleaded Service Position. RIH display shall prompt fueling operator, in conversational language, for each data item to be entered by fueling operator:

a. FMS shall be activated by entry (or verification) of the fueling operator ID number after the bus or vehicle has stopped in the fuel lane.

b. After entry of a valid employee ID number, the RIH unit shall electronically activate the radio frequency receiver unit to electronically read the vehicle number and other data as defined in the Special Equipment Section of these specifications. In the support vehicle positions, the fueling operator shall be prompted to use the Hand Activated receiver for vehicle number and data capture, if equipped.

c. At this point solenoid valves in the diesel or gasoline, engine oil (two types), engine coolant (two types), and ATF (two types) lines shall be energized and opened by the RIH unit.

d. As fuel, engine oil, ATF, or coolant are dispensed into bus or vehicle, quantities of products dispensed shall be sensed and recorded initially by the RIH unit. Electronic pulser/transducers shall sense fuel in tenths of a gallon, and other liquids in tenths of a quar

e. Diesel fuel dispensed shall be displayed on the RIH display as follows:

FUEL D<XXX> YYYYY

where **D** is diesel, **XXX** is the calculated expected fuel required quantity, if available, and *** if not available. **YYYYY** is the actual quantity in tenths of fuel dispensed

f. Diesel fuel dispensed shall be displayed on the RIH display as follows:

FUEL G<XXX> YYYYY

where **G** is gasoline, **XXX** is the calculated expected fuel required quantity, if available, and *** if not available. **YYYYY** is the actual quantity in tenths of fuel dispensed

g. Successive pushing of the SEND button shall cycle the display to show quantities of each of the other fluids dispensed

h. Products and quantities of each dispensed item shall be transmitted by the RIH unit to the System Controller Unit, which shall have capability to retain a minimum of 500,000 fueling transactions.

i. Upon completion of servicing, vehicle traffic sensor installed in each service position shall sense departure of bus or vehicle and cause RIH to terminate transaction.

j. Transaction shall be automatically terminated at end of any 5-minute interval following cessation of servicing operation.

k. Dispensers and solenoid valves to automatically be closed upon exiting of the bus or after 5-minute time out.

7. Sequence of Operations – Diesel Service Position Back-up Mode of Operation. The sequence of operations for servicing vehicles which are not equipped with a FLEETWATCH electronic module or for which there is a malfunction in the on-board electronic module, shall be as follows

a. The sequence shall begin as described above with the entry of the employee ID and the use of the radio frequency receiver unit.

b. After a short time-out period, during which a vehicle number and mileage are not received by any receiver unit, the RIH unit will automatically proceed with a prompt **ENTER VEH NUMBER** and require entry through the keypad of a valid vehicle number for the vehicle to be serviced.

c. For the next step the system shall provide the user the capability to **ENTER MILEAGE** or the system shall automatically calculate mileage based upon fuel dispensed to the vehicle if a mileage is not entered.

d. At this point solenoid valves in the diesel or gasoline, engine oils, coolant, and ATF lines shall be energized and opened by the RIH unit and succeeding steps would be identical to those described in the preceding paragraph.

8. Sequence of Operations – Support Vehicle Fueling Position

a. The sequence of operations for the support vehicle fueling position shall be the same as the Diesel service position with the exception that transaction termination shall be by time out or pushing RESET button only

9. Sequence of Operations – Maintenance Shop Area. RIH display shall prompt operator, in conversational language, for each data item to be entered by mechanic operator.

a. FMS shall be activated by selection of a maintenance bay. RIH shall prompt operator to select a maintenance bay, where the operator shall enter the corresponding bay number:

Prompts: SELECT BAY

b. Next, FMS shall prompt the operator for entry of the mechanic operator ID

Prompts: ENTER VEH NUM

RE-ENTER VEH NUM (if invalid)

c. At this point solenoid valves in the engine oil (both types), engine coolant (both types), and ATF (both types) lines in the selected maintenance bay shall be energized and opened by the RIH unit. Only the engine oil specified for the vehicle to be serviced should be energized.

d. As engine oil (both types), ATF (both types), or engine coolant (both types) are dispensed into the vehicle, quantities of products dispensed shall be sensed and recorded initially by the RIH unit. Electronic pulser/transducers shall sense all products dispensed in tenths of a quart.

e. Successive pushing of the SEND button shall cycle the display to show quantities of each of the fluids dispensed.

f. Products and quantities of each dispensed item shall be transmitted by the RIH unit to the System Controller Unit

g. Transaction shall be automatically terminated at end of any 5-minute interval following cessation of servicing operation or by pushing the RESET button

D. Features and Construction

1. Remote Island Heads:

a. General: RIH shall:

1) Be located at each diesel and gasoline service position for diesel, gasoline, ATF, coolant and oil operation and as required for control and monitoring of ATF, coolant and oil dispensed in the maintenance shop area. Refer to process drawings for location of RIH units.

2) Be the interface between fueling operator, dispenser, traffic sensors, and FMS.

3) Have the capability to enter into a stand-alone mode of operation should the communication to the SYSTEMController be lost or disrupted. RIH shall continue to authorize and record fueling transactions, store the data and transfer data to the SYSTEMController upon reestablished communication.

4) Be weatherproof, vandal resistant, and tamper proof.

5) RIH components shall be plug-in, remove and replace, maintainable.

6) Consist of push-button console with display, mounted on upright stand.

7) Operate in temperature range from 0 degrees F to 120 degrees F, and relative humidity range of 5 to 95 per cent, non-condensing.

b. Keypad: Keypad shall:

1) Be a sealed, flat, pressure sensitive unit providing 16 push-button permanently labeled as follows:

2) 0-9 digits

3) SEND (terminates data entry)

4) CLEAR (clears display)

5) RESET (restarts entry sequence)

6) YES (for entry validation)

7) NO (for entry validation)

c. Display: Display to be alphanumeric, backlit LCD unit with a shatterproof glass face, allowing up to 16 characters to be displayed.

d. Two-Position Key Switch: Provide key-operated switch on face of RIH panel to allow selection of either manual mode or automatic mode. One key shall operate all RIH units. Provide two keys to each RIH unit, but all units shall be keyed alike.

2. SYSTEMController Server:

a. SYSTEMController Server shall be, at a minimum, a rack-mounted IBM PC Compatible running FLEETWATCH SYSTEMController 3.5 software on a Microsoft Windows Server 2008 platform. Controller shall be capable of controlling, receiving, and recording data produced by all RIH units as specified in a Microsoft SQL Server 2008 database. System Controller shall operate independently of agency CPU and communicate with all RIH units through Local Area Network connection only.

b. System Controller Server shall include web-browser (HTML) based software for viewing vehicle, employee, facility and service data without compromising the integrity of the System database. Such software shall include varying levels of security to limit user access.

c. System Controller Server shall accept fueling data, verify vehicle and employee authorization, and store data. System Controller and its RIH units shall be capable of allowing simultaneous transactions of all products without possibility of any confusion of data.

d. System Controller memory shall be nondestructive in the event of power outage, and similar malfunctions.

e. System Controller shall be capable of being connected to, and automatically transmit data to a host computer system. Connection options shall be dial-up, direct connection, or network connection.

f. System Controller shall provide an Ethernet connection for interface to the Tank Monitoring Controller for inventory and fluid receipt data. System Controller software shall also include the capability for Tank Monitor Interface through an Ethernet network connection. Provide software for this System Controller to provide complete fluid use and receipt reports and detailed tank status reports.

g. System Controller Server shall have capability to store 500,000 separate fueling transactions and 15,000 vehicle authorization numbers.

h. System Controller Server shall have capability to store 15,000 employee ID authorization numbers.

i. System Controller Server shall have capability to store the mileage input at the last servicing, the calculated miles per gallon for each authorized vehicle, an upper and lower limit of acceptable miles per gallon for each vehicle, and shall be capable of performing the data verification checks and calculations described in the "SEQUENCE OF OPERATIONS" section of this specification.

3. System Reporting Requirements-The following reports shall be the minimum provided by the System Controller Server software:

a. Detailed Transaction Report - all data associated with a fueling transaction. Format shall be aligned for ease of reading, and shall include the transaction number for monitoring of real-time activities by management. Asterisks shall denote excess consumption of consumables. Reports shall consist of:

1) Date and time of transaction.

2) Transaction number.

3) Totals by servicing lane.

4) Vehicle number (authorized or not).

5) Employee ID.

6) Manual or electronic entry of vehicle number.

7) Fuel type (diesel or gasoline).

8) Fuel quantity.

9) Engine oil quantity.

10) ATF quantity.

11) Coolant fluid quantity

b. Daily Transaction Report - Printed upon request and consisting of the entire previous day's transactions by fleet, shift, service lane, facility, vehicle number and employee number

c. Buses not fueled - Printed daily. This report consists of all in-service buses which have not been fueled at a given time and date

d. Transaction Year-to-Date and Month-to-Date - by commodity, on request

e. Commodity Exception Report - by day, week or month, by commodity

f. Unauthorized Vehicle Service Report - Transactions of those vehicles serviced that are not in the vehicle authorization file. An authorized code number shall replace vehicle number. This report is to be printed each day

g. Vehicle Authorization Status Report - A Master list, printed on request, of valid vehicle numbers consisting of:

1) Vehicle number

2) Facility assigned

3) Fuel type

h. Fueling Operator Authorization Status Report - The complete fueling worker authorization file by name, identification number, and facility assigned. This report is to be printed on request

i. Tank Inventory Report - Shows total gallons of fluid, inches of fluid, inches of water, and temperature in degrees for each tank in the FMS

j. Fluid Use, Receipt, and Inventory Report

4. Traffic Sensors

a. Provide traffic sensor in each service position to sense departure of bus or vehicle. Traffic sensor shall consist of overhead sonar-type proximity detector

E. Special Equipment

1. Bus and Vehicle mounted Data Recorder System- vehicle mounted units to be furnished by FMS manufacturer, installed by owner. Receivers within the building are furnished and installed by FMS manufacturer.

a. System shall include a fixed radio frequency receiver unit positioned in each diesel bus service lane to allow electronic reading of bus number and other data defined in these specifications from vehicles equipped with bus-mounted data recorders. These receiver units shall send a beacon signal that would cause the bus-mounted data recorder to transmit the vehicle number and other data (specified below) for that bus. The receiver unit shall receive such transmitted data, perform data verification checks, and transfer this information directly to the RIH unit.

b. J1708/1939 Data Loggers (Bus-mounted)

1) Included with the system shall be 150 bus-mounted data recorder units suitable for mounting on a transit bus and connecting directly to a J1708/1939 connector on the bus. Bus-mounted data recorders shall be programmable by the owner with vehicle

number and codes for defining the set of data to be recorded and reported. Programming software and hardware shall be provided to allow the owner to program or re-program the bus-mounted data recorder units at any time. Bus-mounted data recorders provided shall include a minimum one-year warranty on all parts, including batteries. Bus-mounted data recorders shall be programmed to respond to a beacon signal sent from a Receiver Unit and upon receipt of such beacon signal shall transmit via radio frequency the bus number and other defined data to the Receiver Unit. Bus-mounted data recorders shall as a minimum provide the following capability:

a) Data always collected and reported:

(1) Vehicle Number

(2) Vehicle Total Mileage

(3) Vehicle Total Engine Hours

b) Fault Indicators captured and reported:

c) Fault Codes reported shall include Subsystem ID and Failure Mode Identifier as defined in SAEJ1587 documentation. Record the last 10 unique Active Fault Codes reported with the Date and Time of the beginning and ending of the last occurrence observed

d) Last value observed: The Bus-mounted data recorder shall report the last value observed for 10 items. The user shall be able to define these 10 items using M.I.D. and P.I. D. codes as defined in SAEJ1587 documentation.

Examples:	M.I.D.	P.I.D.
Engine Idle Hours	128	235
Idle Fuel Used	128	346

e) Maximum and minimum value observed in 24 hours: The Bus-mounted data recorder shall report the maximum and minimum values observed during the previous 24 hour time period for 10 items defined using M.I.D. and P.I.D. codes. The date and time of the minimum and maximum occurrences shall also be reported. The user shall be able to define the codes for the items to be reported.

f) Examples; M.I.D. P.I.D.

Engine Coolant Temperature	128	110
Engine Oil Pressure	128	100
Engine Oil Temperature	128	175
Transmission Oil Temperature	130	177
Ambient Air Temperature	128	171

c. Speedometer Tap Data Loggers (Bus-mounted) for Buses with Non-electronic Engines- System shall include Speedometer Tap Data Loggers for buses without an electronic engine. Each Speedometer Tap data logger shall be suitable for mounting on a transit bus and connecting directly to a speedometer connector on the bus (for example, a Dixson 900 Series). These bus-mounted data recorders shall be programmable by the owner with vehicle number, number of pulses per mile, starting odometer, starting engine hours, and starting idle hours of data to be recorded and reported. Programming software and hardware shall be provided to allow the owner to program or re-program the bus-mounted data recorder units at any time. Bus-mounted data recorders shall be programmed to respond to an encoded beacon signal sent from a Receiver Unit and upon receipt of such beacon signal shall transmit via radio frequency the bus number and other defined data to the Receiver Unit. Speedometer Tap Bus-mounted data recorders shall as a minimum provide the following capability:

1) Data always collected and reported:

a) Vehicle Number

b) Vehicle Total Mileage

c) Vehicle Total Engine Hours

2) Electrical Interface

a) Provide an interface to a sending unit from the vehicle ECM (which may be tapped off of the speedometer interface) to count a square wave signal ranging from approximately 0V to > 5V to determine distance traveled

b) Provide a switched power input (active high signal > 5V) for use in determining when the engine is running in order to calculate idle hours and engine hours

d. GPS-based Data Loggers (for all other vehicles):

System shall include as an option GPS-based Data Loggers for non-electronic buses not utilizing the Speedometer Tap Data Logger and any

support vehicles. This device is a GPS-based odometer calculating distance traveled using GPS coordinates. The GPS-based Data Loggers shall be programmable by the owner with vehicle number and initial starting mileage and electronically identify the vehicle each time the vehicle is fueled. GPS-based Data Loggers shall be programmed to respond to a beacon signal sent from a Receiver Unit and upon receipt of such beacon signal shall transmit via radio frequency the vehicle number, mileage and engine hours to the Receiver Unit.

Programming software and hardware shall be provided to allow the owner to program or re-program the GPS-based Data Loggers units at any time.

F. Controls: All system components shall be protected from overload and meet applicable National Electrical Code requirements.

G. Utilities Available: Two 120 VAC, 20 A dedicated circuits at each RIH.

PART 3 - EXECUTION

3.1 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.

B. Inspect delivered equipment for damage from shipping and exposure to weather.

C. Compare delivered equipment with packing lists and specifications to assure receipt of all items.

3.2 INSTALLATION

A. Perform work under direct supervision of Foreman or Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect.

B. Install equipment in accordance with plans, shop drawings and manufacturer's instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level, plumb and at right angles to adjacent work.

2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.

3. Anchorage: Attach equipment securely to floor, as directed by Architect, to prevent damage resulting from inadequate fastening. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.

4. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.3 TESTING

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to start-up inspect, test, and adjust components, assemblies, and equipment installations, including connections, check operation of the equipment and components for operation and performance as specified and examine the finish for damage. Provide report in writing that the installation meets the requirements and shall include information concerning minor adjustments and minor repairs, which may be required before final acceptance by the Owner.

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment

B. Prepare test and inspection reports

C. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with all specified features in the presence of the Architect using acceptance procedures provided by the manufacturer.

D. Fuel/Fluid Management System Demonstration Acceptance Test:

Once installed, proper operation of the system shall be demonstrated as follows:

-- Electronic transfer of correct vehicle number and mileage from the bus-mounted data recorder module to the RIH unit.

-- Unlocking of fluid solenoid valves after input of valid vehicle and employee ID.

-- Correct measurement of quantity of fuel, oil, ATF, DEF and coolant dispensed.

-- Relocking of fluid valves upon automatic detection of vehicle exit from service position.

-- Default time-out and relock of valves after five minutes of no flow with vehicle remaining in service position.

-- All of the above five (5) tests with the RIH unit in standalone mode.

-- Correct data transmission from RIH unit to System Controller Server with subsequent logging of the service transaction.

-- Storage of service transactions and subsequent transfer from System Controller Server to MAXIMO Vehicle Maintenance Software.

3.4 CLEANUP

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing or installation debris from job site.

D. Notify Architect for acceptance inspection.

3.5 TRAINING

A. Direct the technical representative to provide specified hours of training to designated

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment

C. Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.

1. FUEL/FLUID MANAGEMENT SYSTEM, TRANSIT
Equipment Mark Number: 8210
Hours Required: minimum of 4 hours total

a. The vendor shall provide training for computer, servicing, and maintenance personnel in use and maintenance of the Fluid Management System hardware and software supplied. Such training shall consist of one one-hour on-site training session for service personnel at the service positions during actual servicing. Training shall also be provided at the location of the System Controller to provide computer personnel with an overview of the total system operation and detailed instructions on running of reports and file maintenance. Such training is to consist of a two-hour training session. A one-hour training session shall also be provided to train designated personnel in the maintenance and troubleshooting of Fluid Management System Equipment.

b. Provide training and oversee the installation of bus mounted transmitters installed by the owner.

D. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

E. Provide a Windows compatible movie file format recording on DVD disk of the training session. The DVD training movie can be of a live session or a produced training video.

F. Over the course of a one year period from substantial completion provide a minimum of 2 additional visits to verify the system is operating properly and correct unusual conditions.

END OF SECTION 111400

SECTION 115100 - SHOP EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

1.2 WORK INCLUDED

A. Equipment items as listed below by Equipment Mark Number:

1. BUFFER/GRINDER, 8 INCH, WITH DUST COLLECTOR
   Equipment Mark Number: 2080
   Submittal requirements: PD, OM

2. CAGE, INFLATION, TIRE
   Equipment Mark Number: 2110
   Submittal requirements: PD

3. CHARGER, BATTERY, FIXED
   Equipment Mark Number: 2130
   Submittal requirements: PD, OM

4. DRILL PRESS, VARIABLE SPEED, 18 INCH
   Equipment Mark Number: 2210
   Submittal requirements: PD , OM

5. ABRASIVE BLASTING CABINET
   Equipment Mark Number: 2270
   Submittal requirements: PD, OM

6. BUS TIRE MOUNTER/DEMOUNTER
   Equipment Mark Number: 2450
   Submittal requirements: PD, OM

7. PARATRANSIT TIRE MOUNTER/DEMOUNTER
   Equipment Mark Number: 2451
   Submittal requirements: PD, OM

8. PRESS, ELECTRIC/HYDRAULIC, 80 TON
   Equipment Mark Number: 2535
   Submittal requirements: PD, OM

9. REFRIGERANT RECLAMATION SYSTEM, PORTABLE, R-12/22/134
   Equipment Mark Number: 2640
   Submittal requirements: PD, OM

10. METAL HAND BREAK
Equipment Mark Number: 2670
Submittal requirements: PD, OM

11. METAL SHEAR
Equipment Mark Number: 2671
Submittal requirements: PD, OM

12. PORTABLE BRAKE LATHE
Equipment Mark Number: 2674
Submittal requirements: PD, OM

13. BUS BRAKE LATHE
Equipment Mark Number: 2675
Submittal requirements: PD, OM

14. LATHE
Equipment Mark Number: 2680
Submittal requirements: PD, OM

15. SAW, BAND
Equipment Mark Number: 2690
Submittal requirements: PD, OM

16. ABRASIVE METAL MITRE SAW
Equipment Mark Number: 2714
Submittal requirements: PD, OM

17. VISE
Equipment Mark Number: 2832
Submittal requirements: PD

18. WELDER, MIG
Equipment Mark Number: 2900
Submittal requirements: PD, OM

19. OXYACETYLENE TORCH
Equipment Mark Number: 2920
Submittal requirements: PD, OM

20. PLASMA CUTTER
Equipment Mark Number: 2925
Submittal requirements: PD, OM

21. WELDER, TIG
Equipment Mark Number: 2935
Submittal requirements: PD, OM

22. FLOOR SCRUBBER
Equipment Mark Number: 3357
Submittal requirements: PD, OM

23. TANK, PARTS CLEANING
Equipment Mark Number: 3560
Submittal requirements: PD, OM

24. PORTABLE VACUUM SYSTEM
Equipment Mark Number: 3624
Submittal requirements: PD, OM

25. WASHER, PARTS, SMALL
Equipment Mark Number: 3785
Submittal requirements: PD, OM

26. WHEEL BALANCER, ELECTRONIC, BUS
Equipment Mark Number: 4912
Submittal requirements: PD, OM

27. WHEEL BALANCER, ELECTRONIC, PARATRANSIT
Equipment Mark Number: 4913
Submittal requirements: PD, OM

28. CART, BATTERY LIFT
Equipment Mark Number: 5015
Submittal requirements: PD

29. WHEEL DOLLY
Equipment Mark Number: 5312
Submittal requirements: PD, OM

30. JACK STAND-TALL
Equipment Mark Number: 5313
Submittal requirements: PD

31. JACK STAND- SHORT
Equipment Mark Number: 5314
Submittal requirements: PD

32. ALIGNMENT MACHINE
Equipment Mark Number: 5705
Submittal requirements: PD, OM, SD, T

33. ALIGNMENT CONTROLLER
Equipment Mark Number: 5706
Submittal requirements: PD, OM, SD, T

34. BOOTH, PAINT, OPEN FACED
Equipment Mark Number: 6108
Submittal requirements: PD, OM, SD, T

35. PERSONNEL FALL PROTECTION
Equipment Mark Number 6235
Submittal requirements: PD, OM, SD, T

36. SHAKER, PAINT
Equipment Mark Number: 6670
Submittal requirements: PD, OM

37. DRAIN PAN, PORTABLE, USED OIL
Equipment Mark Number: 8165
Submittal requirements: PD, OM

38. DRAIN PAN, PORTABLE, USED COOLANT
Equipment Mark Number: 8166
Submittal requirements: PD, OM

39. OIL FILTER PRESS
Equipment Mark Number: 8492
Submittal requirements: PD, OM

40. FILTER, ELCTROSTATIC, PORTABLE
Equipment Mark Number: 9350
Submittal requirements: PD, OM

41. SPILL KIT
Equipment Mark Number: 9985
Submittal requirements: PD

B. Provide roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.

1. Coordinate and verify all electrical and utility connections with all trades prior to equipment ordering and purchase.

C. Piping, wiring, and switching between equipment and utilities.

1.3 QUALITY ASSURANCE

A. All components shall be factory tested and documented to operate as a complete system

B. Manufacturer's Representative: The manufacturer authorized representative shall be factory trained and certified personnel providing service, startup, and quality control field labor for the project from their local office.

1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out and start up.

2. Training: Provide technical representative to train Owner's maintenance personnel in operation and maintenance of specified equipment.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

E. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. Refer to above submittal requirements. The following abbreviations are used to indentify submittals required:

1. PD- Product Data

2. SD- Shop drawings

3. OM- Operation and Maintenance manual

4. T- Training of owners personnel on specific equipment items.

C. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical requirements, wiring diagrams, and provided accessories.

1. Restrict submitted material to pertinent data. For instance, do not include manufacturer's complete catalog when pertinent information is contained on a single page.

D. Shop drawings and schematics detailing fabrication, installation, piping layout, materials and finishes, system interconnections, and utility connections of equipment assemblies. Indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

1.5 INFORMATION SUBMITTALS

A. Factory tests and inspection reports prior to shipping.

B. Field test and start-up reports, indicating and interpreting test results relative to compliance with specified requirements, for information.

C. Certificates: For certification required in "Quality Assurance" Article

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For the equipment identified to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set(s) for each belt-driven unit

2. Filters: one set for each unit containing a filter

1.8 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, function and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough, or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.

D. All parts shall be readily available locally in the United States.

E. Any units or parts which prove defective during the warranty period will be replaced with OEM parts and transportation prepaid

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid, dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Mark Number of this specification.

C. Provide equipment and materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

1.10 LABELING

A. Nameplate: Manufacturer shall securely attach in a prominent location on each major item of equipment a non-corrosive nameplate with stamped figures showing manufacturer's name, address, model number, serial number and pertinent utility or operating data.

B. Lifting capacity shall be painted with letters and numbers 3 inches high Minimum on both sides of lifting mast assembly.

C. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (U.L.), or other National Recognized Testing Laboratory (NRTL), in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant

PART 2 – PRODUCTS

2.1 BUFFER/GRINDER, 8 INCH, WITH DUST COLLECTOR
Equipment Mark Number: 2080

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Cincinnati Electrical Tool, Inc.

B. Capacities and Dimensions:

1. Buffer/grinder:

a. Motor: 3/4 HP, 3600 RPM.

b. Minimum Wheel dimensions:

1) Diameter: 8 inches.

2) Thickness: 1 inch.

3) Bore: 3/4 inch.

2. Dust collector:

a. Motor: 1/2 HP, 3,600 RPM.

C. Features and Construction:

1. Motors: Motors shall be totally enclosed, direct drive, and rated for continuous service, with permanently lubricated ball bearings.

2. Wheels: Unit shall be provided standard, with two grinding wheels; one coarse and one medium grit.

3. Wheel guards: Telescoping guards shall be adjustable for wheel wear, and provided with exhaust outlets, adjustable work rests, and spark breakers.

4. Dust collector with reusable filters: The collector shall be an integral part of the cabinet base, provided with front-opening doors for access to motor and filters, and removable dust drawer. Entire unit shall meet OSHA ventilation standards.

5. Conduits: Flexible dust collection conduits shall permit guard adjustment without disturbing connections.

6. Tool tray and water pot: Pot shall be mounted on grinder base between wheels.

7. Power cord: Unit shall be provided with connections for hookup to fused disconnect.

D. Controls: Pushbutton safety starter shall have ON/OFF pushbutton switch; motor thermal overload and under voltage protection. Switching and other electrical controls shall meet applicable National Electrical Code requirements.

E. Accessories:

1. Illuminated eyeshields installed with transformer, Cincinnati No. 000-131, one set of two each per grinder.

2. Magnetic starter, Cincinnati No. 000-532.

F. Utilities Available: 480 VAC, 3 phase, 1-1/4 HP.

G. Finish: Durable enamel in manufacturer's standard color.

2.2 CAGE, INFLATION, TIRE
Equipment Mark Number: 2110

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Branick Industries, Incorporated

B. Capacities and Dimensions:

1. Tire capacity: 12.00-24 inches (maximum 50 inch outside diameter).

C. Features and Construction: 5 bar all welded steel construction with high tensile 2-1/4” diameter steel tubing, base plate, and side plates.

D. Finish: Durable enamel in manufacturer's standard color.

2.3 CHARGER, BATTERY, FIXED
Equipment Mark Number: 2130

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Associated Equipment Corporation

B. Capacities and Dimensions:

1. DC output rating: 70 amps

2. Charging capacity: 1 to 15, 12 VDC batteries.

3. Clamp rating: 400 amps.

C. Features and Construction:

1. Battery Types: 12 Volt Flooded, AGM, and Gel Cell batteries- including Spiral Cell, Orbital, or Optima batteries.

2. Cabinet: Unit shall be enclosed in bonderized steel cabinet with reinforced frame and gasketed access panel.

3. Display: Analog meter and 3 LED display indicating charge status.

4. AC cord: 6’ 16 gauge-3

5. DC leads: 6.5’, 4 AWG

6. Electrical stability system technology

7. Program for deep discharge recovery of flooded batteries.

8. Diagnostic capability to indicate weak or defective batteries.

D. Accessories: Bus bar set with fiberglass backboard assembly shall be complete with connecting cables, insulated clamp storage bar, and 10 pair of 10 gauge, 300 amp rated charging leads, 36 inches long premounted at bus bar end with vinyl insulated safety clamps on other end Provide with three foot 4 AWG cables to connect to charger or additional bus bars. Associated No. 6075, quantity two of four each.

E. Utilities Available: 120 VAC, 1 phase,.

F. Finish: Durable enamel in manufacturer's standard color.

2.4 DRILL PRESS, VARIABLE SPEED, 18 INCH
Equipment Mark Number: 2210

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Delta Machinery

B. Capacities and Dimensions:

1. Motor: 3/4 HP, 1,725 RPM.

2. Minimum working dimensions:

a. Chuck to table: 22-1/4 inches.

b. Chuck to base: 42-1/2 inches.

3. Minimum table working surface, ground:

a. Width: 20 inches, inside coolant trough.

b. Depth: 14 inches, inside coolant trough.

4. Quill:

   a. Minimum Stroke: 0 to 6 inches.

   b. Minimum Diameter: 2-3/8 inches.

5. Spindle: Morse #2

6. Speeds: 170 to 3,000 RPM.

7. Chuck capacity: 5/8”

C. Features and Construction:

1. Speed control: Speed control shall be operable while machine is running and shall hold speed setting constant under all rated load conditions.

2. Belt drive: Alignment and tension of belt shall be automatically maintained.

3. Bearings: Spindle assembly shall be supported by not fewer than eight permanently lubricated ball bearings.

4. Work table: Diagonal and parallel T-slots for clamping and a removable center insert for through table drilling.

   a. Bevel: 0 degrees to 90 degrees left and right

   b. Tilt: Forward 0 degrees to 48 degrees.

5. Table lock: Expanding bushing table lock shall be provided for rigid positioning of table at any angle.

6. Floor base: Two full-length T-slots shall permit insertion of T-bolts from front and rear.

7. Micro- Adjustable Depth Stops and independent Depth Scale allows the user to zero scale the set up for repetitive drilling, quickly and easily.

8. Fully adjustable laser projects a bright red crosshair on the work piece at the point of bit contact.

9. Flexible LED light to illuminate the work surface.

10. Non-tip base

11. Safety features:

   a. Chuck key: Unit shall include self-ejecting chuck key.

   b. Guard: Steel clip on guard shall completely enclose drive.

12. Spindle: No. 3 Morse Taper shall accept accessory Jacobs type chuck for use with standard bits.

13. Motor: Unit shall be totally enclosed, fan cooled.

14. Depth control: Self-locking adjustment depth stop shall be provided for feed.

15. Table adjustment: Hand gear crank shall permit table elevation.

16. Function controls: Knobbed spoke wheels shall be provided for manual speed selection and feed.

17. Power cord: Unit shall be provided with a minimum 6-foot power cord and plug compatible with facility's receptacles.

D. Controls: 24 volt pushbutton control station with shrouded START button and protruding STOP button, magnetic starter with transformer and no voltage/low voltage and three leg overload protection. Switches and other electrical controls shall meet applicable National Electrical Code requirements.

E. Accessories: Drill Chuck, Delta No. 17-820, one each.

F. Utilities Available: 120 VAC, 1 phase, 3/4 HP.

G. Finish: Durable enamel in manufacturer's standard color.

2.5 ABRASIVE BLASTING CABINET

Equipment Mark Number: 2270

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by TP Tools and Equipment

B. Capacities and Dimensions:

1. Motor: 7 Amp vacuum motor

2. Minimum working Dimensions:

a. Width: 46 inches

b. Depth: 28 inches

c. Height: 28 inches

C. Features and Construction:

1. Cabinet: 20 gauge steel

2. Door: Right-hand side-loading 11 gauge steel with angle iron frame work.

3. Lens: 12”x33” side tempered glass lens and frame with inner lens protector.

4. Lights: two 120 watt, 115 V adjustable flood lamps

5. Vacuum: 7 amp Vac-40 vacuum to remove dust

6. Nozzles: 1 steel and 2 ceramic nozzles.

7. Gloves: 28”L double-strength cabinet gloves

8. 50 pounds fast-cutting Skat Magic Abrasive

9. Automatic abrasive recycling system.

10. Expanded metal screen to hold objects up to 200 pounds

11. Quick change trap door for fast abrasive changes.

12. Power cord: Unit shall be provided with a minimum 6-foot power cord and plug compatible with facility's receptacles.

D. Controls:

1. C-25 foot-pedal-operated power gun and foot pedal with 7 ft of air hose.

E. Accessories:

1. Provide 1 additional steel nozzles and 2 additional ceramic nozzles.

2. Provide 50 pounds additional fast-cutting Skat Magic Abrasive.

3. Provide 5 ft of vacuum hose.

F. Utilities Available:

1. Electrical: 120VAC, 1 phase

2. Air: 10-15 cfm @ 80 psi

G. Finish: Epoxy coated red

2.6 BUS TIRE MOUNTER/ DEMOUNTER
Equipment Mark Number: 2450

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Hennessy Industries

B. Capacities and Dimensions:

1. Wheel capacity:

a. Width: Greater than 25 inches.

b. Max tire diameter: 76 inches

c. Rim Diameter range: 15 inches to 38 inches

C. Features and Construction:

1. Adaptability: Changer shall be capable of mounting and demounting tubeless tires for all 15 degree single piece highway truck rims demountable (Dayton), standard disc wheels, and reverse disc (Budd) wheels and shall also break beads for tube type tires.

2. Positioning: Pivoting work table shall permit operation at any angle.

3. Wheel clamping: 3 jaw chuck

4. Rotation: Mounting/demounting rotates in either direction at 6 RPM.

5. Bead breaking: Designed with pinch action to loosen both beads simultaneously.

6. Function controls: Two way foot pedal for bead loosening; PUSH/PULL control stick for table pivot; twist control stick for wheel clamping; dual two way foot pedals for mounting/demounting.

7. Table: Moving table centered in frame

8. Mount and demount: Independent hook and roller

9. Provide the following standard features:

a. Five foot pry bar
b. Lube bucket
c. Lube applicator
d. Earth mover bead loosener roller shaft
e. Tubeless tire iron
f. Lock ring iron
g. Drop center iron

h. Bead starting tool
i. Vise grip
j. Stud piloted budd wheel plate

10. Provide the following optional features
a. Portable ramp
b. Offset roller assembly for wider applications

11. Power supply: Connections for hookup to junction box.

D. Controls: ON/OFF switching and other electrical controls shall meet applicable National Electrical Code requirements.

E. Utilities Available:

1. Electrical: 208 VAC, 1 phase, 20 Amp.

F. Finish: Durable enamel in manufacturer's standard color.

2.7 PARATRASIT TIRE MOUNTER/DEMOUNTER
Equipment Mark Number: 2451

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Hennessy Industries

B. Capacities and Dimensions:

1. Wheel capacity:

a. Rim width: 1 ½ inches to 19 inches

b. Tire Diameter: 38 inches max outside

c. Rim diameter: 10 inches to 17 ½ inches

C. Features and Construction:

1. Operation: single positioning bead loosening and changing

2. Mount/demount: Separate tool

3. Table shape: contoured

4. Wheel clamping method: Center cone

5. Bead sealing reservoir: 7.5 gallon tank

6. Inflation gauge : 60 psi

7. Air supply gauge: 0-300 psi

8. Standard Protectors: tool bar covers, mount and demount ends

9. Provide the following standard features:

   a. Lube applicator
   b. Lube bottle
   c. Bead lift tool
   d. Hose with air chuck
   e. Inflation safety limiter
   f. Filter lubricator

10. Provide the following optional features:
   a. Positioning pin extension
   b. 4 inch center post extension
   c. 8 inch center post extension
   d. Deep hub adaptor
   e. 5” small hold down cone

D. Controls:

1. Bead loosening: Foot-controlled tower

E. Utilities Available:

1. Air: 5 scfm @ 110 to 175 psi

F. Finish: Durable enamel in manufacturer's standard color

2.8 PRESS, ELECTRIC/HYDRAULIC, 80 TON
Equipment Mark Number: 2535

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Nugier Press Company, Inc.

B. Capacities and Dimensions:

1. Minimum capacity: 80 tons.

2. Minimum inside width: 48 inches.

3. Minimum width between table rails: 8 inches.

4. Table travel: 32 inches.

5. Maximum vertical clearance: 41 inches

6. Ram travel: 14 inches.

7. Approximate ram speed:

   a. Advance: 100 IPM.

   b. Return: 182 IPM.

8. Minimum ram diameter: 3-1/4 inches.

9. Minimum cylinder bore: 3-1/2 inches.

10. Minimum table spacing increments: 4 inches.

11. Minimum left to right cylinder movement: 34 inches.

12. Pump motor size: 7.5 HP.

C. Features and Construction:

1. Hydraulic pump and motor: The hydraulic pump, motor, and reservoir shall be contained in module located outside the press frame.

   a. Pump: The hydraulic pump shall be a high quality, constant flow, radial piston type without packing and shall be direct coupled to the drive motor.

   b. Motor: The pump drive motor shall be a 7.5 HP pump flange mounted motor with a 1.15 service duty rating, single acting.

2. Movable cylinder: The press head and cylinder (ram) shall be movable from side to side of the head rails. Quick acting 90 degree locking cams shall lock the head at desired location.

3. Table: The press table shall be vertically adjustable with a self-locking table winch and cable that is mounted outside of frame.

4. Construction: Press shall have all channel ends and corners cut and ground for safety.

   a. Frame uprights: The press frame uprights shall be fabricated of steel channels.

   b. Head and table rails: Head and table rails shall be fabricated of steel.

   c. Base members: Both press and pump module base members shall be fabricated of steel angle.

   d. Table locking pins: Press shall have a minimum of four locking pins.

5. Equipment protection: The press shall have a ram travel limit valve to prevent overextension of ram and a maximum capacity relief valve to prevent loading more than 110 percent of press capacity. An adjustable pressure relief valve shall also be provided to allow press operator to set maximum pressure at any point between zero and maximum capacity.

6. Power supply: Connections for hookup to junction box

7. Controls: Press controls shall be mounted on the pump module located outside the press frame so that the front of the press is clear.

a. Hydraulic controls: There shall be two hand operated hydraulic valves.

b. ON-OFF control: Pump motor shall be controlled by a pushbutton magnetic starter with overload protection.

c. Gauge: A large, dial type pressure gauge shall be mounted on the outside of the press frame to isolate gauge from mechanical shock.

8. Standard accessories: Press shall include two flat parallels with "V" grooves, two "V" ram noses, and two flat ram noses as standard accessories.

D. Accessories: Round ram nose, Hypress No. FRN-80, one each.

E. Utilities Available: 480 VAC, 3 phase, 7.5 HP.

F. Finish: Durable enamel in manufacturer's standard color.

2.9 REFRIGERANT RECLAMATION SYSTEM, PORTABLE, R-12/22/134
Equipment Mark No. 2640

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Van Steenburgh Engineering Laboratories

B. General Description: Combination portable recovery, recycling, evacuation, and recharging for R-12, R-134a, R-22, R-502, MP, and HP type refrigerant fluids.

C. Capacities and Dimensions:

1. Tanks: minimum 30 pound refillable..

2. Operating range: 50 to 105 F.

3. Recovery rate:

a. Vapor: slightly less than 3 pound per minute.

b. Liquid: 3 pound per minute.

4. Sub-cooled refrigerant recirculation rate: 300-400 lbs/hr.

5. Caster: 3in heavy-duty ball bearing.

6. Compressor- 1 Hp hermetic compressor

D. Features and Construction:

1. Float chamber: Unit shall posses a float chamber that automatically adjusts from liquid to vapor.

2. Measurable oil capable of weighing recovered refrigerant and protecting tank overfilling.

3. Lockout panel: Unit shall include a lockout panel to prevent mixing of refrigerants.

4. Recycling: Unit shall be capable of recycling, making an initial pass through the filter-drier. Additional recycling shall be programmable in case of compressor burnout or other conditions.

5. Filter-drier: Unit shall include a filter-drier capable of removing moisture and acid from the refrigerant with a capacity of 300 - 400 pounds an hour.

6. Chill chambers- capable of sub-cooling refrigerant to 15 to 40 degrees F.

7. Liquid injection during vapor removal- pump a cylinder or system to atmosphere pressure without harm to the compressor.

8. Non-condensing separation- “air out” switch allows non-condensables to be purged.

9. Tanks and fittings: One tank shall have 1/4 inch fittings and the other shall have 1/4 inch ACME fittings. Charging hoses shall be included for R-12, R-134a, and one other for refrigerants using 1/4 inch SAE fittings.

10. Power cord: Unit shall be provided with a minimum 6-foot power cord and plug compatible with facility's receptacles.

E. Utilities Available: 120 VAC, 1 phase, 1HP

2.10 METAL HAND BREAK
Equipment Mark Number: 2670

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Roper Whitney Corporation.

B. Capacities and Dimensions
1. Capacity: 12 gauge mild steel

2. Maximum bending length: 97 inches

3. Maximum jaw opening: 1.75 inches

4. Minimum reverse bend: 3/8 inches

5. Minimum flange bend: 1 inch

6. Maximum bend angle (past horizontal): 45 degrees

C. Features and Construction

1. Hand brake to accommodate combination bending. In addition to straight bending, box and pan work, inside bending, radius bending and other intricate forming operations can be performed.

2. Provide with lower beam clamping

D. Controls:

1. Manually hand operated by the user

E. Finish

1. Durable enamel in manufacturer's standard color

2.11 SHEAR, METAL

Equipment Mark Number: 2671

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Roper Whitney Corporation.

B. Capacities and Dimensions:

1. Maximum shearing length: 52"
2. Maximum back gauge range: 25"
3. Maximum front gauge range: 30"
4. Maximum slitting gauge range: 18"
5. Floor space, gauges in position: 91" x 78"
6. Max. rated capacity, mild steel: 16 Ga.
7. Weight: 1850 lbs
8. Overall Dimensions:
   a. Width: 91 inches
   b. Depth: 55 inches
   c. Height: 60 inches

C. Features and construction:

1. Heavy cast metal bed and frame. Shear frame shall incorporate gap-in-housing feature to permit slitting sheets of any length by successive cuts up to 18 inches wide.

2. Safety features: Shear shall include shatterproof transparent finger guards, treadle stops, and well guards for safety.
3. Shearing: Triple action shearing shall include relief on both edges of both the fixed and moving blades.
4. Gauges: Front and back gauges shall be adjustable -with 1/16 inch engraved graduations. Shear shall have an adjustable side slitting gauge.
5. Hold downs: Shear shall be designed to automatically engage lever actuated holddown before shearing.
6. Treadle: Shearing operation shall be accomplished by foot operated treadle.

D. Finish: Durable enamel in manufacturer's standard color.

2.12 PORTABLE BRAKE LATHE
Equipment Mark Number: 2674

A. Manufacturers
   a. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Hunter Engineering Company

B. Capacities and Dimensions
   1. Trolley range:
      a. High position: 32-45 inches
      b. Low position: 22-32 inches
   2. Rotor maximum:
      a. Diameter: 17.5 inches
      b. Width: 3.5 inches
   3. Feed distance: 5.75 inches
   4. Spindle speed: Adjustable and automatically variable: 0-120 rpm

C. Features and Construction
   1. Machine to provide bub-mounted service to eliminate the need to disassemble the hub to remove the rotor.
   2. Medium and heavy duty applications.
   3. Lathe to be provided with anti chatter technology to minimize machining problems by virtually eliminating chatter. The computerized system oscillates the speed of the lathe while machining the rotor to prevent the buildup of vibration.
   4. Computerized compensation adjusts for lateral runout to assist the technician with meeting OEM specifications.

5. Power cord: Unit shall be provided with a minimum 6-foot power cord and NEMA L6-20P plug compatible with facility's receptacles.

6. Lockable caster wheels allow the unit to be moved into place.

7. Unit to be provided with pivoting control module allowing operation in the upright position on either side of the vehicle.

D. Accessories
1. 22 mm socket wrench

2. Micro-runout insert kit

3. Right and and left hand tool holder

4. 6mm T-wrench

5. 8mm wrench

6. Shaft extension

7. Extended twin cutter tool assembly

8. Quckcomp adaptor kit

9. Provide one adaptor and lug nut kit for each type of rotor serviced by the client.

E. Controls: ON/OFF switching and other electrical controls shall meet applicable National Electrical Code requirements.

F. Utilities Available
1. Electrical: 208 VAC, 1 phase, 9 amp, 1.5 Hp

G. Finish
1. Durable enamel in manufacturer's standard color Finish

2.13 LATHE
Equipment Mark Number: 2680

A. Manufacturers
a. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Jet tools

B. Minimum Capacities and Dimensions
1. Swing over bed: 9 inches

2. Swing over cross slide: 5-5/16 inches

3. Distance between centers: 20 inches

4. Spindle bore: 7/8 inches

5. Number of spindle speeds: 6

6. Range of spindle speeds: 130-2,000 rpm

7. Max tool size: 1/2x1/2

8. Width of bed: 4-1/2 inches

C. Features and Construction

1. Purpose: lathe shall turn bus, truck, car, and small motor armatures

2. Construction: heavy cast steel

3. Spindle supported by precision tapered roller bearings

4. Hardened and ground bedways

5. Provided with reversing switch

6. Backsplash adjustments provided throughout the carriage

7. Quick change gearbox to provide a wide range of inch and metric threads

8. Power longitudinal feed to allow threading and reverse threading

9. Tailstock to be adjustable for taper cuts

10. Power cord: Unit shall be provided with a minimum 6-foot power cord and grounding plug compatible with facility's receptacles

D. Accessories

1. 4” 3-jaw chuck with threaded backplate

2. 7” 4-jaw chuck with threaded backplate

3. Heavy duty stand

4. Provide two steel centers, and two carbide tipped tool bit

E. Controls: ON/OFF switching and other electrical controls shall meet applicable National Electrical Code requirements.

F. Utilities Available

1. Electrical: 120 VAC, 1 phase, ¾ Hp

G. Finish

1. Durable enamel in manufacturer's standard color Finish

2.14 SAW, BAND
Equipment Mark Number: 2690

A. Manufacturers
1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Wellsaw

B. Capacities and Dimensions:

1. Motor: 1/2 HP OPD.

2. Minimum horizontal cutting capacity:

a. Rectangular cut: 9-1/2 by 11 inches wide.

b. Round cut: 9-1/2 inches diameter.

c. 45 degree cut: 5-1/2 by 5-1/2 inches.

3. Minimum vertical cutting capacity:

a. Work table: 8 by 10 inches.

b. Throat: 9-1/2 inches high by 6-1/4 inches deep.

4. Blade speeds: 76, 141, and 268 feet per minute.

5. Minimum blade size: 1/2 by 93 inches.

6. Band Wheels: minimum 11” cast iron.

7. Minimum height to top of bed: 26 inches.

C. Features and Construction:

1. Conversion: Saw shall be capable of operation in either vertical or horizontal mode. Conversion from one mode to the other shall be accomplished by self-locking frame release latch and installing or removing vertical work table.

2. Blade support: Ball bearing blade guides shall be provided for full three-way blade support.

3. Drives: There shall be a three speed V-belt drive system from motor with gear and pinion drive to blade.

4. Blade speed change: A stepped pulley shall provide for blade speed change.

5. Frame feed: Frame feed downward motion shall be adjustable.

6. Coolant system: A submersible coolant pump and four gallon capacity reservoir shall be provided.

7. Vise: Manual screw/quick action- A dog and ratchet mechanism type vise with locating pins for modification to 45 degree cuts shall be provided.

8. Fabrication: Saw frame shall be constructed of welded angle steel with sheet steel panels.

9. Mobility:

a. Retractable wheel assembly: Two rubber wheels shall be mounted on front legs of saw frame with foot actuated jacking lever.

b. Pull Handle

10. Handle: A pull-out type handle shall automatically lock saw head in down position.

11. Adjustable stock stop

12. Replaceable pivot bar and bushing

13. OSHA blade guards

14. Power cord: A 6 foot, three wire power cord shall include a grounded plug.

15. Provide stock stand

D. Controls: ON/OFF switch shall be mounted in a control box, equipped with overload and low voltage protection.

E. Utilities Available: 120 VAC, 1/2 HP.

F. Finish: Durable enamel in manufacturer's standard color.

2.15 ABRASIVE METAL MITRE SAW
Equipment Mark Number: 2713

A. Manufacturers
1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Kalamazoo Industries, Incorporated.

B. Capacities and Dimensions:

1. Motor Hp: 5 Hp

2. Minimum cutting capacities:

a. 2 ½” Solids

b. 3” pipe

c. 3.5” at 45 degrees

3. Blade diameter: 14 inches.

4. Arbor shaft: 1 inch. Sealed ball bearings.

5. Spindle RPM: 4400.

C. Features and Construction:

1. Miters either direction 45 degrees

2. Positive index holes and up/down stops

3. Heavy duty stand

a. 12 gauge plain steel top

4. Front table lock

5. Dual cam vises

D. Controls: Manual starter with integral ON/OFF switching, overload protection.

E. Accessories:

1. Abrasive wheel 14 inch diameter, 3/32 inch thickness, medium grit fiberglass reinforced

F. Utilities Available:

1. Electrical: 208 VAC, 3 phase, 5 hp.

2. Provide motor starter disconnect switch mounted to unit for single point connection.

G. Finish: Durable enamel in manufacturer's standard color.

2.16 VISE
Equipment Mark Number: 2832

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Reed Manufacturing Company.

B. Capacities and Dimensions:

1. Minimum jaw width: 5 inches.

2. Minimum jaw opening: 6 inches.

3. Minimum throat depth: 6-1/4 inches.

4. Minimum pipe capacity: 1/8 to 4-1/2 inches.

C. Features and Construction:

1. Slide bar: Machined steel slide bar with oil port shall operate in machined channel.

2. Base: 360 degree swivel base shall include locking device.

3. Construction: Semi-steel cast body shall include hardened tool steel nut and screw.

4. Jaws: Main and pipe jaw facings shall be replaceable.

5. Wear compensation: Adjustable collar shall eliminate handle slack.

D. Finish: Durable enamel in manufacturer's standard color.

2.17 WELDER, MIG
Equipment Mark Number: 2900

A. Manufacturers
1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Miller Electric Manufacturing Company

B. Capacities and Dimensions:

1. Rated output:

a. 250 amps at 28 VDC, 40 percent duty cycle.

b. 200 amps at 28 VDC, 60 percent duty cycle.

2. Open circuit voltage, maximum: 38.

3. Amps input at rated output, single phase, 60 hertz:

a. 208 volts: 48.

b. KVA: 9.8.

c. KW: 7.5.

4. Amperage range: 30 to 300.

5. Wire feed speed: 50 to 700 IPM.

6. Wire type and diameter:

a. Solid steel: .023 to .045 inches.

b. Stainless: .023 to .045 inches.

c. Flux cored: .030 to .045 inches.

C. Features and Construction:

1. Operation: Welder shall be DC output device capable of performing MIG and Flux-Cored welding operations from 22-gauge to 1/2 inch thick in a single pass.

2. Wire feeder: Welder shall include a built-in wire feeder mounted in a compartment with hinged door to protect components. The drive system shall be aluminum dual gear and quick-change reversible drive rolls with a scaled tension knob.

3. MIG gun: Welder shall include a 15-foot, 250 amp, MIG gun with durable one-piece handle, one million cycle rated trigger and steel spring coils protecting cable ends.

4. Auto gun detect- Automatically detects and recall voltage, wire feed speed and timer of the active gun.

5. Dual front handles- split handle with rubber grips designed to move machine easily and allow work lead and MIG gun to be stored independently

6. Angled wire drive- industrial aluminum dual-gear drive system.

7. Extra drive rolls stored next to drive motor.

8. Flip-down compartment hold parameter chart and storage for consumables.

9. Fan-on demand cooling system only operates when needed.

10. Run-in control: Run-in control shall be adjustable and individually settable for both MIG and spool guns and located on the front panel, allowing the user to optimize starts to their application.

11. Voltage/speed meters: Meters shall be digital self-calibrating digital capable of presetting voltage and wire feed speed. Wire feed speed meter shall be capable of displaying feed speed rate of spool reels.

12. Work cable: Welder shall include a 10-foot work cable with clamp.

13. Housing: Welder components shall be enclosed in a heavy formed sheet metal housing with two 8 inch fixed polyolefin wheels, two four inch swivel front wheel, handle assembly, capable of mounting and securing two shielding gas cylinders at rear of unit. Cooling fan motor shall be a totally enclosed, permanently lubricated, sleeve bearing type. All controls shall be front-mounted for easy access and visibility.

14. Power cord: Welder shall be provided with a 10 foot power cord and NEMA 6-50R plug compatible with the facility's welding receptacles.

15. Spool gun for aluminum welding with 30 foot cable assembly, built-in gas valve, adjustable barrel assembly, 180 degree spool canister, gun handle wire speed adjustment and reversible drive roll. Model Spoolmatic 30A, No. 130 831, one each.

16. Dual cylinder rack for welder mounting of two shielding gas cylinders, Model No. 300 337, one each.

17. Regulator/flow gauge with hose for additional shielding gas cylinder, Model No. 195 050, one each.

18. One pack of ten contact tips, 0.035 inch, Model No. 000 068.

19. One pack of ten contact tips, 0.045 inch, Model No. 000 069.

20. One pack of two nozzle adapters, Model No. 169 729.

21. One pack of two contact tip adapter, Model No. 169 728.

22. One 5/8 inch diameter orifice nozzle, Model No. 169 726.

D. Controls: Controls shall be located on the front panel of welder and include built-in digital timers menu to preset voltage and Wire Speed Control. Standard run-in, pre/postflow, burnback, spot/delay (stitch) timer menu. Front panel to include Power Switch, Voltmeter and Wire Feed Speed Meter.

E. Utilities Available: 208 VAC, 1 phase, 48A.

F. Finish: Durable enamel in manufacturer's standard color.

2.18 WELDING CURTAIN
Equipment Mark Number: 2910

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Steiner Industries

B. Capacities and Dimensions

1. Minimum length: 20 feet

2. Minimum height: 7 feet

C. Features and Construction:

1. Curtain material: 13 oz flame retardant vinyl laminated polyester. Coordinate color with owner prior to ordering.

2. Installation method: wall mounted

3. 16 gauge galvanized steel track system with durable, smooth rolling nylon roller-hooks.

4. Metal chain to be sewn into bottom hem to reduce curtain movement in drafty areas.

5. Curtain section to incorporate hook and loop closures sewn along the vertical edges to provide seamless connections and easy access to enclosed spaces.

D. Accessories

1. Provide all required mounting hardware

2.19 PORTABLE WELDING CURTAIN
Equipment Mark Number: 2915

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Steiner Industries

B. Capacities and Dimensions

1. Maximum length: 4 feet

2. Maximum height: 5 feet

3. Three sections

C. Features and Construction:

1. Curtain material: 13 oz flame retardant vinyl laminated polyester. Coordinate color with owner prior to ordering.

2. Framing: Heavy duty 18 gauge steel 1 inch square tube frame, 1-1/8 inch tube corners and legs with quick snap connections.

3. 2 inch high locking caster wheels attached to platform leg to accommodate mobility.

4. Slip-fit construction

5. Any screen to be used horizontally or vertically

6. Provide with 24 inch study platform legs. Legs to be adjustable 90 degrees to prevent worker interference.

2.20 OXYACETYLENE TORCH
Equipment Mark Number: 2920

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by WCTA / Lincoln Electric Company.

B. Capacities and Dimensions:

1. Acetylene working pressure: 0 to 15 PSI.

2. Acetylene tank pressure: 0 to 200 PSI.

3. Oxygen working pressure: 0 to 80 PSI.

4. Oxygen tank pressure: 0 to 3,000 PSI.

5. Cuts up to 1” thick and welds up to 1/8”

6. Torch hose: Twin oxy acetylene 3/16-inch diameter by 240 inches long.

C. Features and Construction:

1. Materials: Regulator bodies, torch handles, and flow and pressure valves shall be brass and stainless steel construction.

2. Seals: Double "O" ring seals shall be used on all attachments to permit hand tighten of connections.

3. Welding specification: Ready to weld up to 1/4-inch material.

4. Cutting specification: Ready to cut up to 1/2-inch material.

5. Standard equipment:

a. Safety check valves:

1) Acetylene.

2) Oxygen.

b. Goggles.

c. Torch handle.

d. Cutting attachment.

e. Gas mixer.

f. 20 feet of double lined hose.

g. Flint torch lighter.

h. Regulators with gauges:

1) Acetylene.

2) Oxygen.

i. Spark lighter.

D. Accessories:

1. Welding tips: No.0 Part:1600840; No.2 Part:1600860; No.4 Part: 1600880.

2. Cutting tips: No.0 Part:1500830.

3. Heating tips: No.6 Part:1800710.

4. Soapstone holder: KH541, one each.

5. Soapstone: KH542, one set of ten each.

6. Lighter flints: KH571, one box of five single flints.

7. Tip cleaners: KH575, one case of 10 each.

8. Gas dual cylinder cart: Model No. K1702-1, one each.

2.21 PLASMA CUTTER
Equipment Mark Number: 2925

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Miller Electric Manufacturing Company.

B. Capacities and Dimensions:

1. Rated output: 60 amps at 140 VDC, 50 percent duty cycle (230V).

2. Open circuit voltage, maximum: 230 VDC.

3. Amps input at rated output, single phase, 60 hertz:

a. 208 volts: 47 amps

b. KVA: 9.9.

c. KW: 9.8.

4. Plasma Gas Flow/Pressure: 6.75 CFM at 90 PSI.

C. Features and Construction:

1. Operation: Welder shall be an air plasma device with a rated cutting capable of 7/8 inch mild/stainless steel and a maximum severe cutting capable of 1-1/4 inch mild/stainless steel.

2. Cutting torch: Welder shall include ICE-60T hand-held plasma-cutting torch with 50 foot cable, epoxy shield cup, cup mounted drag shield and quick-disconnect.

3. Line votage compensation- provides peak performance power under variable input voltage conditions (+-15%) for steady and cleaner ending cuts.

4. Fan on-demand cooling circuit: cooling system operates only when needed. Welder shall include a post flow circuit that calculates the length of postflow time to provide shielding gas after the torch trigger is released to extend the life ofconsumables and welding torch.

5. Pilot arc switch: Welder shall allow the operator to cut grates, chain link fence and other perforated metals automatically without re-triggering the gun.

6. Gas/air supply: Welder shall include a built-in automatic gas/air filter and regulator and a quick connect gas/air fitting.

7. Work cable: Welder shall include a 50-foot work cable with clamp.

8. Housing: Welder components shall be enclosed in a heavy formed sheet metal housing. Cooling fan motor shall be a totally enclosed, permanently lubricated, sleeve bearing type. All controls shall be front-mounted for easy access and visibility.

9. Power cord: Welder shall be provided with a minimum 10 foot power cord and NEMA 6-50R plug compatible with the facility's welding receptacles.

D. Controls: Controls shall be located on the front panel of welder and include Pilot Arc Switch, Gas/Air Pressure Gauge, Output Control, Trouble Lights (Pressure Light, Cup Light and Temperature Light), Ready Light, Power Light and Power Switch.

E. Accessories:

1. Plasma circle-cutting guides: Guide set for cutting straight lines or circles up to 12 inches in diameter, Model No. 195-981, one each.

2. Roller guide to assist operator in obtaining recommended standoff distances, to maximize cutting performance and improve tip life, Model No. 194-883, one each.

3. Running gear and cord warp, Model No. 300-511, one each.

4. Cart, model 300-511, one each.

F. Utilities Available: 208 VAC, 1 phase, 47A.

G. Finish: Durable enamel in manufacturer's standard color.

2.22 WELDER, TIG
Equipment Mark Number: 2935

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Miller Electric Manufacturing Company

B. Capacities and Dimensions:

1. Rated output:

a. 250 amps at 30 VAC, 40 percent duty cycle.

2. Open circuit voltage, maximum: 80 VDC.

3. Amps input at AC balance, rated load, single phase, 60 hertz (without Power Factor Correction):

a. 250 amps at 30 VAC, 40percent duty cycle.

1) 480 volts: 48.

2) KVA: 21.98.

3) KW: 11.76.

4. Welding amp range: 3 to 310.

C. Features and Construction:

1. Syncro start: Welder shall have a syncro start feature that allows the operator to choose three different starting conditions to optimize the application according to tungsten diameter and material thickness.

2. Integrated cooler: Welder shall include an integrated 3-gallon cooler with cool-on-demand that monitors coolant and temperature. A visual indicator ensures that the coolant is flowing. Cooler only runs when necessary to prevent torch damage by monitoring coolant flow and temperature. An external coolant filter stops foreign objects from entering the water cooled torch cable for better flow and longer life.

3. Squarewave output with AC balance control: Welder shall include squarewave output with AC balance control which features adjustable penetration and cleaning action while increasing arc stability on various aluminum alloys, and helps eliminate tungsten spitting and arc rectification.

4. Dual digital meters: Allow for quick and easy viewing of actual and preset values of amperage and voltage. Allows for greater accuracy and repeatability in the welding procedure.

5. Built-in cable hanger: Welder shall include a built-in cable hanger that conveniently folds out of power supply to allow all weld cables to be neatly stored to prevent torch or cable damage.

6. Built-in preflow and built-in postflow: Welder shall include a calculated built-in preflow that will protect the weld area prior to striking an arc and built-in postflow that will protect the weld area and tungsten when welding is complete.

7. Help message: Welder shall include help messages that provide assistance to the operator about output status for machine circuitry.

8. Last procedure recall: Welder shall feature last procedure recall that automatically recalls the last procedure set-up when switching polarity to simplify process changes.

9. Fan-on-demand: Welder shall feature fan-on-demand which improves power efficiency, reduces noise and maintenance by reducing the amount of airborne contaminants pulled through the machine.

10. Housing: Welder components shall be enclosed in a heavy formed sheet metal housing. All controls shall be front-mounted for easy access and visibility.

11. Running gear: Welder shall include a No. 37 Running gear which includes two 10 inch wheels, two 5 inch caster, two-compartment rack (for gas cylinders or coolant system), and handles.

12. Remote foot control: Welder shall include foot control with a larger base and a heavy 20-foot cord with 14-pin plug that can exit the front, back, or either side of the pedal that can provide remote current and contactor control.

13. Power cord: Welder shall be provided with a minimum 20 foot power cord and plug compatible with the facility's welding receptacles.

14. Low conductivity coolant: Solid in cases of four one gallon recyclable plastic bottles of coolants that contains a base of ethylene glycol and deionized water to protect against freezing to -37°F or boiling to 227°F. Miller No. 043 810, one each.

15. Water-cooled torch with torch accessories, including: torch with 23ft cable, cable cover, accessory kit, regulator/flowmeter, gas hose, torch adaptor, weld lead with clamp and dinse connector, shielding cups, and Collets and Collet Bodies at 1/16 inch, 3/32 inch, 1/8 inch increments.

16. Work lead with clamp, 15 feet.

17. Gas hose, 12 feet

18. Dinse 50mm connectors, two each.

D. Controls: Controls shall be located on the front panel of welder and include Voltmeter Display, Start Mode Control, Output Control, Amperage Control, Process Control, Balance/Dig Control, Postflow Time Control, Ammeter Display, Pulser Control, Background Amps Control, Pulse-Per-Second Control, Peak Time Control, Spot Time Control, Final Slope Control, Initial Time Control, Final Amperage Control, Initial Amperage Control, Amperage Adjustment Control, Power Switch, Output Selector Switch.

E. Accessories:

1. Remote contactor and current control: Side-to-side, rotary-motion, torch mounted, fingertip remote contactor and current control. Miller No. 151 086, one each.

2. Pulser module: Field kit for welding of thin materials. Provides a heating and cooling effect of the weld puddle to reduce heat input and control distortion of the material. Provides 0.25 to 10 pulses per second. Miller No. 195 344, one each.

3. Water-cooled torch kit- includes torch with 23ft cable, cable cover, accessory kit, regulator/flowmeter, gas hose, torch adaptor, and weld lead with clamp and dinse connector.

4. Sequencer module: Field kit that provides a starting current higher or lower than the welding current. Provides final slope and final current for trailing the weld. Provides a spot timer for the TIG spot application. Miller No. 195 345, one each.

F. Utilities Available: 480 VAC, 1 phase, 48A.

G. Finish: Durable enamel in manufacturer's standard color.

2.23 FLOOR SCRUBBER
Equipment Mark Number: 3357

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Tennant Company

B. Capacities and Dimensions:

1. Scrubbing paths: 36 inches

2. Forward speed: 0 to 3.1 MPH

3. Brushes:

a. Type: 36 inch cylindrical, two each

b. Motors: 3/4 hp, two each

c. Down pressure: 0 to 90 pounds

4. Solution tank: Minimum 30 gallons

5. Recovery tank: Minimum 40 gallons

6. Batteries: 6 volt, 335 AHC, six each

7. Minimum aisle turn: 67-1/2 inches, maximum

8. Maximum overall dimensions, nominal:

a. Length: 63 inches

b. Width (body): 28.25 inches

c. Width (scrub head): 38.25 inches

d. Height: 43 inches

9. Gradeability (full/empty): 6 degrees/8 degrees

10. Features and Construction:

a. Construction: Frame shall be glass fiber reinforced and high impact resistant. Brush housing shall be 3/16 inch aluminum with the scrub head being impact resistant. Tanks shall be rotationally molded polyethylene.

b. Operating system: The operators console shall be height adjustable and water resistant with an hour meter gauge and battery discharge indictor. Unit shall have power forward and reverse and brushes and water shall automatically shut off when the machine is stopped.

c. Scrubbing system: Brushes shall be designed for use on rough textured floors and attached with a spring clip system requiring no tools for changes. Brushes shall pick up small debris commonly found on floors during scrub operation without operator adjustment. For easy serviceability, the scrub head shall be modular and removed with four pins and three disconnects, requiring no tools.

d. Recycling system: Unit shall be equipped with a system that recycles the solution, which enables up to three hours of continuous runtime. Recovery and pick up systems that do not leave the floor virtually dry will not be accepted.

e. Vacuum fan: The vacuum fan shall be a 14,000 rpm, dual 0.8 hp, two-stage, 73-inch water lift with stainless steel permanent lint filter and tangential discharge. Fan shall be at least 4 inches above the waterline with the recovery tank having a 10-gallon demisting system that causes air to change direction at least four times.

f. Squeegee: The squeegee shall be of parabolic breakaway design. The squeegee assembly shall be a free floating swing type constructed of non-rusting stainless steel and aluminum with the squeegee capable of swinging to wrap around front wheels to allow all water to be picked up on 180 degree turns. No tools shall be required on either the front or rear squeegee for change outs.

g. Propelling system: The transaxle shall be completely sealed, maintenance free gear-type with two pneumatic, foam filled, non-marking, 4.1 x 3.5 x 6 inch tires and two 5 inch neoprene, non-marking casters.

h. Battery charger: 30 amp with automatic shut off.

i. Power cord: provide with a minimum 6 foot power cord and plug compatible with the facility's welding receptacles

11. Utilities Available: 120 VAC, 30 A

12. Finish: Durable enamel in manufacturer’s standard color

2.24 TANK, PARTS CLEANING
Equipment Mark Number: 3560

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Better Engineering.

B. Capacities and Dimensions:

1. Pump motor: 5 HP.

2. Minimum pump output: 100 GPM/50 PSI

3. Turntable diameter: Minimum 37 inches

4. Work height: Minimum 48 inches

5. Load height capacity: Minimum 28 inches

6. Fluid capacity: Minimum 110 gallons.

7. Weight capacity: Minimum 1500 lbs

8. Heat: 18kW

C. Features and Construction:

1. Non solvent based.

2. Roll in door- center supported Flush hose: Flexible metal hose shall include nozzle and valve.

3. Vertical (seal-less) pump- No bearings or seal below the solution level. .

4. TEFC pump motor with extended shafts that connect directly to the pump impellers (no couplings).

5. Automatic water level controls: Unit shall have electronic solution control that monitors and maintains solution levels. Monitor shall terminate power to unit when fluid level is not at correct operational height .

6. Jam-free turntable drive system.

7. Oil skimmer.

8. Slide-out filter basket

9. Low water warning and shut-down

10. 12 hr heat timer and 30 min wash timer

11. Sealed cleaning chamber

12. Mid-swing cleaning manifold

13. Construction: Unit shall be constructed of 14 gauge and 16 gauge stainless steel.

14. Clean out: 2-inch NPT bottom drain plug and removable sludge trays shall be included.

15. Power supply: Hardwire with electrical disconnect .

D. Controls: Recessed switch with amber POWER ON light. Switching and other electrical controls shall meet applicable National Electrical Code requirements.

E. Accessories:

1. Automatic 7-day/24 hour timer

2. Casters

3. Steam exhaust

4. In-line strainer

5. Insulation

6. Brush and pump for hand cleaning

7. Automatic low water shut down and automatic water fill

8. Bag Filter installed between the pump and the spray manifolds

9. Hydro-air rinse gun for manual rinsing

10. Small parts basket with lid (12x6x6)

11. Small parts basket (15x9x6)

12. Removable center rod to stabilize part

13. Removable parts “tree” to hang small parts

F. Utilities:

1. Electric: 480 VAC,60 hz, 3 phase, 31 FLA

2. Water: 1/2 inch.

3. Drain: 2 inch NPT

G. Finish: Durable enamel in manufacturer's standard color.

H. Construction: Provide all stainless steel construction.

2.25 PORTABLE VACUUM SYSTEM
Equipment Mark Number: 3624

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Dynabrade.

B. Capacities and Dimensions:

1. Storage capacity: Minimum 9.9 gallons

2. Water pressure static lift: Minimum 90 inches

3. Sound level: Maximum 76 Decibels

C. Features and Construction

1. Number of vacuum outlets: 2

2. Number of pneumatic outlets: 2

3. Construction: stainless steel drum with plastic and metal components

4. Variable speed vacuum control

5. HEPA filtration (0.3 micron) with felt insert and paper bag.

6. Power cord: Provide with a minimum 26 foot power cord and plug compatible with the facility's welding receptacles

D. Controls: Variable speed vacuum control. Electronic thermal protection device prevents heat overload of motor.

E. Accessories:

1. x2- 1 1/4 inch I.D. x 20’ long light weight coaxial hose with built in 3/8 inch I.D air supply tubing.

2. Wall mount bracket

3. One disposable paper bag

F. Utilities:

1. Electric: 120 VAC,60 hz, 1 phase, 27 foot plug connection

2.26 WASHER, PARTS SMALL
Equipment Mark Number: 3785

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Zep equipment

B. Capacities and Dimensions:

1. Pump:

a. Pump output: Maximum 168 gph.

2. Minimum tank size

a. Width: 36”

b. Depth: 24”

c. Height: 28”

3. Reservoir capacity: 35 gallons.

4. Agitating capacity: 400 pounds

a. 10 cfm @ 100 psi to agitate

C. Features and Construction:

1. Cabinet: 10 gauge steel

2. Adjustable agitation speed up to 160 strokes per minute

3. Spring-loaded lid for easy opening and closing

4. Flow through brush with on-off control

5. Two particulate filtration systems, 100 micron and 50 micron

6. Visible filter bowls and change indicator signal when filters need to be changed

7. 165 degree F UL approved fire link. In the event of a fire the platform will lower and the lid closes automatically.

8. Connection for filter bag

9. Power supply: Provide 115 volt 10’ grounded power cord.

D. Accessories:

1. Provide Dyna 170 solvent based cleaner to fill unit.

2. Provide Dyna-trap filter bag

E. Utilities Available:

1. Electrical: 120 VAC, 1 phase, 1 amp

F. Finish: Baked-on epoxy powder coated.

2.27 WHEEL BALANCER, ELECTRONIC, BUS
Equipment Mark Number: 4912

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Hennessy Industries

B. Capacities and Dimensions:

1. Motor:

a. 1.5 HP direct drive, forced air cooling, large housing for heat dissipation, and heavy duty class F insulation for high temperatures applications.

b. Rated for 850 RPM.

2. Rim diameter: 16 to 26 inches.

3. Rim width: 4-1/2 to 18 inches.

4. Maximum tire diameter: 46 inches

5. Wheel weight: 45 pounds minimum to 350 pounds maximum.

C. Features and Construction:

1. Cycle time: Cycle time shall be an average 31 seconds (200 lbs), start to finish. Average time for truck tires is 12 seconds.

2. Accuracy: Calibration accuracy shall be 1/2 ounce in truck mode.

3. Displays: LED display shall indicate weight and position for both planes of the wheel.

4. Guard hood: Hood shall be included as standard equipment with micro-switch interlock to prevent tire spinning unless guard hood is in position over wheel.

5. Start button: Unit shall be equipped with push ON to start spin balance and automatic stop.

6. Emergency stop: Emergency STOP button shall be mounted on front of base cabinet.

7. Power cord: Unit shall be provided with a minimum 6-foot power cord and plug compatible with facility's receptacles.

8. Bud wheel adaptor: Hennessy PN 143935, one each.

9. Truck hub centered cone set, model 109877.

10. Self calibration.

11. Single spin dynamic, static, and RV balancing modes.

12. Automatic hub nut loosening feature, a back/front cone mounting system, and a removable stub shaft.

13. Controls: LED digital display with keypad data entry and computerized control panel.

14. Standard accessories:

a. 5/16 allen wrench

b. Weight hammer

c. 6401 threaded stud

d. Accessory peg

e. Hood springs

f. Caliper

g. Small cone

h. Medium cone

i. Large cone

j. Truck cone

k. Truck cone spacer

l. Back cone spring

m. Pressure drum

n. Hubnut wrench, large

o. Bubnut wrench, small

p. Hubnut

D. Utilities Available: 208 VAC, 3 phase, .

E. Accessories:

1. Dayton wheel adaptor: (Hennessy PN 8110785) 20 to 22-1/2 inches, one each.

2. Wheel lift, model 0501.

3. Combi adapter for most truck wheels.

F. Finish: Durable enamel in manufacturer's standard color.

2.28 WHEEL BALANCER, ELECTRONIC, PARATRANSIT
Equipment Mark Number: 4913

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Hennessy Industries

B. Capacities and Dimensions:

1. Motor:

a. 1.5 HP direct drive, forced air cooling, large housing for heat dissipation, and heavy duty class F insulation for high temperatures applications.

b. Rated for 900 RPM.

2. Rim width: 2 to 19 inches.

3. Maximum tire diameter: 40 inches

4. Wheel weight: 45 pounds minimum to 150 pounds maximum.

C. Features and Construction:

1. Cycle time: 5 seconds average

2. Accuracy: Calibration accuracy shall be .01 ounces

3. Resolution shall be .01 ounces and 1.4 degrees

4. Provide up to 8 balance modes- static and dynamic modes, RV and four different alloy modes, plus match mount.

5. 16 bit microprocessor

6. Automatic distance parameter entry

7. Operator “A” and “B” features to accommodate two technicians using it at one time.

8. Ounce/gram selectable readings with roundoff

9. Automatic self calibration

10. Weight and adaptor storage.

11. Displays: LED display shall indicate weight and position for both planes of the wheel.

12. Guard hood: Hood shall be included as standard equipment with micro-switch interlock to prevent tire spinning unless guard hood is in position over wheel.

13. Start button: Unit shall be equipped with push ON to start spin balance and automatic stop.

14. Emergency stop: Emergency STOP button shall be mounted on front of base cabinet.

15. Power cord: Unit shall be provided with a minimum 6-foot power cord and plug compatible with facility's receptacles.

16. Controls: LED digital display with keypad data entry and computerized control panel.

17. Standard Accessories

a. Graduated Cone Assortment (hardened, 3 piece)

b. Large adapter (truck cone)

c. Cone spring

d. Hub nut

e. No-mar ring

f. Rim width calipers

g. Wheel weight pliers

D. Utilities Available: 208 VAC, 3 phase.

E. Accessories:

1. Extra large truck cone kit

2. 3,4, and 5 lug universal adapters

3. Combi-adapter for bolt hole mounting

F. Finish: Durable enamel in manufacturer's standard color.

2.29 CART, BATTERY LIFT
Equipment Mark Number: 5015

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Global Industrial Equipment.

B. Capacities and Dimensions:

1. Load capacity: 750 pounds.

2. Lowered height: 5 3/4 inches.

3. Lift: 54 inches.

4. Minimum platform dimensions:

a. Width: 30 inches.

b. Depth: 22 inches.

C. Features and Construction:

1. Construction: Steel frame and braces shall be welded construction.

2. Table adjustments: Foot operated hydraulic pump shall raise and lower table 1-1/4 vertical inches with each stroke of the fold away foot pedal. Hydraulic pump shall have valve for selection of RAISE or LOWER mode.

3. Wheels: Rubber tread 8”x2” rear tires shall be mounted on metal wheels with roller ball bearing hubs. Front lower truck frame shall be equipped with two 3-1/2” casters for positioning of vehicle.

D. Finish: Durable enamel in manufacturer's standard color.

2.30 WHEEL DOLLY
Equipment Mark Number: 5312

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by SEFAC.

B. Capacities and Dimensions:

1. Lifting capacity: Minimum 1500 pounds.

2. Extended height: Minimum 36 inches.

3. Safety chain length: Minimum 72 inches.

4. Fork Adjustment: 16 inches to 26 inches

C. Features and Construction:

1. Construction: Heavy steel welded construction.

2. Lifting crank: Hand pumped hydraulic cylinder enables lifting and lowering of roller supports.

3. Safety chain: Chain with hook to hold wheel set in place during removal and transport.

4. Roller support arms: Pull out extension for tandem wheels.

5. Rear mounted swivel casters for tight turning radius

D. Finish: Durable enamel in manufacturer's standard color.

2.31 JACK STAND- TALL
Equipment Mark Number: 5313

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by SEFAC

B. Capacities and Dimensions:

1. Height adjustment: 53 inches to 80 inches

2. Capacity: Minimum 36,000 pounds.

3. 8 positions- 21 inch

4. Fine adjustments- 6 inches

C. Features and Construction:

1. Construction: Heavy steel welded construction.

2. Tri pod stand with 2 fixed wheels for portability.

3. Spring assisted support adjustment

4. 6 inches of threaded adjustment for flexible height adjustment

5. 7-1/2 inch diameter head for safe and secure engagement with the vehicle

6. 2-1/2 inch incremental pin adjustment

D. Finish: Durable enamel in manufacturer's standard color.

2.32 JACK STAND- SMALL
Equipment Mark Number: 5314|

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by SEFAC

B. Capacities and Dimensions:

1. Height adjustment: 26-1/2 inches to 44 inches

2. Capacity: Minimum 36,000 pounds.

3. 7 positions at 2-1/2 inch centers

4. Fine adjustments- 4 inches

C. Features and Construction:

1. Construction: Heavy steel welded construction.

2. Tri pod stand with 2 fixed wheels for portability.

3. 4 inches of threaded adjustment for flexible height adjustment

4. 7-1/2 inch diameter head for safe and secure engagement with the vehicle

5. 2-1/2 inch incremental pin adjustment

D. Finish: Durable enamel in manufacturer's standard color.

2.33 ALIGNMENT MACHINE
Equipment Mark Number: 5705

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Hunter Engineering Company.

B. Capacities and Dimensions:

1. Minimum axle capacity: 18,000 lbs front axle rating.

2. Full 58” pit depth.

3. Pit Size: 18’-0” long x 15’-0” Wide x 58”Deep.

4. T-Extension : 22’3” long x 2’-10” wide x 58” deep

5. Radius gauge load capacity, each: 9,000 lbs (18000 lbs per pair.)

6. Runway length, nominal: end of pit to center of radius gauge 61.50 inches.

7. Runway width: 18 inches.

8. Adjustable tread width range: 52 inches to 102 inches (min.- max center line.)

9. Runway and Pedestal Width Adjustment: 34” to 120”, cable operated.

C. Features and Construction

1. T-extension with full length rail support system and HD pit jack to provide both front and rear axle lifting. Rail support to extend full length of t-pit and into alignment pit to accommodate front axle lifting.

2. Removable heavy-duty runways.

3. Two (2) sets of stairs, one on either side.

4. Two (2) Wheel Stops.

5. Complete with all anchors and installation hardware.

6. Material: Steel construction

D. Accessories:

1. Stainless Steel Heavy duty electronic truck turnplates to input angle measurements directly into alignment controller software.

2. Provide extra rail kit as required.

3. Provide HD pit jack

a. Air powered and hydraulically driven

b. Cylinders to be individually adjusted from side to side

c. Choice to use both cylinders or just one cylinder for center point lifting

d. Capacity rating of 17,500 pounds per cylinder or 32,500 pounds total

e. Provide with built in storage area for accessories.

E. Finish: Powder coated for maximum protection and appearance in Manufacturers standard color.

2.34 ALIGNMENT CONTROLLER
Equipment Mark Number: 5706

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Hunter Engineering Company

B. Features and Construction:

1. Standard PC Hardware/Software

2. Personal Computer.

a. Processor: 3.06 GHz Intel Core i3 (or greater)

b. Memory: 5 GB Sata hard drive (or greater)

c. Monitor class: 24” Widescreen LCD

d. Wireless Network Module

e. Operating system: Windows 7

f. DVD-RW/CD-RW Drive

g. Power cord: Unit shall be provided with a minimum 6-foot power cord and plug compatible with facility's receptacles

3. Standard Accessories:

a. Color Printer

b. Keyboard

c. Mouse

d. Wireless Remote Control

e. Steering Wheel Holder

f. Brake Pedal Depressor

g. HD Turning Angle Gauges

4. Software:

a. WinAlign HD Alignment Software for Heavy-Duty Trucks

b. Vehicle Specification Database

c. Color measurement display- color coded camber, toe and thrust angle measurements after compensation.

5. Sensors:

a. Four (4) Cordless Optical Sensors.: Part No. DSP506TXF. XF transmitter in each sensor sends data to the control console.

b. Rechargeable batteries power sensors for full day continuous operation. Provide docking stations to charge batteries between jobs

c. Self Centering Adaptors to fit wheels 15 to 28 inches. Provide with optional extensions to accommodate owners wheel diameters.

d. Tire Diameter Measuring Tool

e. Optical infrared emitter/CCD’s read cross-toe, front-to-rear and wheelbase/trackwidth

f. Solid state digital inclination transducers measure caster. Camber, and SAI

6. Icon Cordless Remote Indicator- Part No. 30-421-1

7. Adaptor (for Mounting sensor to hub center)- Part No. 175-284-1

8. Two (2) Rim Stud Extension Kits – Part No. 20-823-1

9. Two (2) Rim Stud Sleeve Kits – Part No. 20-1522-1

10. HD Frame Offset Measuring Tool – Part No. 221-646-1

11. Calibration Fixture: 221-625-1-T

12. Equipment Cover: Part No. 69-1025-2

C. Utilities Available:

1. Electrical: 120 VAC. 1 phase

2.35 BOOTH, PAINT, OPEN FACED
Equipment Mark Number: 6108

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Global Finishing Solutions.

B. General Description: Open face type paint booth for use in painting 8'x4' panels. Booth air shall be supplied through the use of a makeup unit. Air intake chamber shall supply the booth with the necessary airflow for painting operations. Clean air is introduced into the booth through an intake plenum at the end of the room, and is exhausted through a plenum at the rear of the booth. Air is pulled horizontally from the front of the room through the working depth at an average velocity of approximately 125 fpm.. The intake plenum is designed with high efficiency intake filters to remove dust and dirt before it enters the paint booth. Air entering the room will be ducted directly from the intake air source (Heated AMU) into the booth intake plenum, bypassing potentially contaminated shop air. The booth is designed with the maximized filter quantity to assure efficient particulate filtration from the intake and exhaust filters. The air shall then be drawn from the exhaust chamber and exhausted from the system and facility by means of ductwork and plenums.

C. Paint booth to be UL listed. Provide in field inspection by certified inspector to provide required UL listing

D. Capacities and Dimensions:

1. Minimum interior clearances:

a. Width: 10 feet 0 inches.

b. Depth: 6 feet 0 inches.

c. Height: 8 feet 0 inches.

2. Maximum exterior dimensions:

a. Width: 10 feet 4 inches.

b. Depth: 9 feet 2 inches.

c. Height: 8 feet 2 inches

E. Airflow rate: 125 FPM average over cross sectional area of empty booth

F. Lighting fixtures:

a. Type: Fluorescent four tube NFPA and OSHA code approved, inside access, 265 mA, 32 watt, 120 VAC, Class I, Division II, ETL and ETL-C approved fixtures with T-8 ballast and clear tempered glass. Provide calculations confirming acceptable light levels.

b. Lights to listed for locations having deposits of readily combustible paint residue.

c. Instant start (starting temperatures at 0 degrees F)

d. Lamp holders to be twist in style

e. Front/inside access for easy lamp replacement and equipped with an interlock switch to disable painting operations when light access door is opened.

f. Lamps: 48 inch 85% color correct fluorescent tubes, four tube

G. Features and Construction:

1. Construction: Paint booth shall be constructed of minimum 18-gauge galvanized steel sheets and supported by structural I-beams at regular intervals for rigidity and integrity. Panels are to be pre-punched, companion flanged, bolted on six inch centers, and have exterior flanges to provide a smooth interior surface. Booth shall be mounted directly to the concrete slab.

2. Booth structural design to accommodate installation of booth as shown on drawings.

3. Intake/exhaust system: A fully filtered exhaust air system shall be adequate for specified airflow rate and static pressures, complete with exhaust fan, make-up air unit, and TEFC motor assembly. Provide exhaust stacks, ductwork, weather caps, roof curbs, automatic dampers, counter flashings, and hardware necessary for a complete and operable installation

a. Industrial style exhaust filter chamber:

1) Exhaust filters: Continuous filament glass fibers with open weave pattern. UL Class 2 approved. Provide adequate quantity to permit one complete filter change. Provide draft gauge for exhaust chamber to monitor filter restriction

b. Solid back intake filter chamber

1) Intake filters: Two-ply resilient polyester fibers with a better tackifier capable of extracting 100 percent of visible dust and

removing 90 percent of micron particles. Internal welded steel frame with self-sealing gasket. Internal wire support and heat-sealed seams. Provide adequate quantity to permit one complete filter change. Provide draft gauge for intake chamber to monitor filter restriction.

H. Exhaust system:

1. Exhaust fan to be provided by booth manufacturer

2. Exhaust capacity: 10,000 CFM total at .6 inch water column static pressure.

3. Fan will be roof mounted

4. Tube axial- Continuously welded housing for an airtight seal and painted with a thermal setting polyester urethane coating (Permatector).

5. Propellers are to be non-sparking cast aluminum for consistent air velocity at higher static pressures.

6. Adjustable belt tensioning

7. Bearings- premium air handling quality, self-aligning, 400,000 hour life at maximum operating speed.

8. Totally enclosed belt guard

9. Provide motor starter disconnect switch

10. Provide 18” high roof curb with counter flashing to support fan

11. Provide 30” diameter spiral ductwork from the booth to the exhaust fan with connecting rings on both ends.

12. Provide 30” diameter spiral ductwork attached to fan discharge with access doors. Extend ductwork such that top of ventilator is 10 feet above the finished room. Provide required guy wire supports and anchor to provide required structural supports to withstand snow and wind loading.

13. Provide motorized insulated damper at the roof penetration. Damper to open when fan is energized and close when fan is de-energized. Damper to have a maximum leakage rate of 4 cfm per square foot at 1.0 inch water gauge and tested in accordance with AMCA 500D. Damper size to match roof opening. Actuator to be spring open power closed.

14. Provide automatic roof ventilator with relief dampers to prevent rain and snow intrusion. Provide required guy wire supports and anchor to provide required structural supports to withstand snow and wind loading.

15. Motor:

    a. 3 HP - 480/3 phase, 60 Hz

b. TEFC high efficiency

c. Motor out of airstream.

d. Variable pitch drive sheave

e. Heavy gauge steel frame, double sealed ball bearings mechanically locked on the shaft end, and bolt on motor base.

f. 1.15 service factor

g. UL recognized and CSA certified

16. Fan diameter: 30 inches

I. Heated air makeup system: Indirect gas fired type heated air makeup unit suitable for installation outside the building to provide tempered air as required for comfortable working conditions. Unit shall be factory assembled, flame tested, pre-wired for automatic operation, and complete as a packaged assembly with the booth.

1. Make-up air unit to be provided by booth manufacturer.

2. Volume capacity: 10,000 CFM total at 1.0” total external static pressure

3. H2 horizontal unit arrangement with down discharge

4. 100% replacement air make-up air unit to be provided by booth manufacturer

5. Heat output: 90 degree temperature rise, 1,215 MBTUH input, 7” min natural gas pressure, 14” max

6. Motor: Constant air volume 10 HP heavy duty ball bearing type.

a. Open Drip Proof

b. High Efficiency EPACT

c. High temperature motor

d. 480 volt/3 phase

e. Motor and fan to be mounted on 1” deflection spring vibration isolators. Provide a flexible duct connection from the fan outlet to the units casing

f. Class F insulation

7. ETL labeled

8. Horizontal arrangement

9. ABB ACH550 VFD NEMA 12

10. V-bank filter section with permanent filters

11. Casing:

    a. Double walled G-90 16 gauge cold rolled steel, painted, enamel

        1) Color selected by architect

    b. Roof panel shall be a minimum of 16 gauge cold rolled steel.

    c. Interlocked wall seam and roof panels

    d. Weatherproof construction

    e. Hinged double wall insulated access doors with continuous flush mount stainless steel hinges.

    f. Insulation- 1”, 1.5 lb density insulation adhered and mechanically fastened to casing.

    g. Welded steel frame

12. Gas burner and heat exchanger: The gas burner shall be indirect fired, push-through type, designed for natural gas, FM approved gas train, including modulating main gas proportioning valve, main and pilot gas regulators, and main gas automatic safety shut-off. Pilot assembly shall include flame rod and automatic spark ignition.

    a. Burner shall be a tubular in-shot fired design.

    b. Burner ignition shall be of the direct-spark design with remote flame sensing at inlet of the last firing tube of the gas manifold.

    c. Each burner ignition module shall be pre-programmed with a ignition sequence comprised of a 1 minute pre-purge, 1 min inter-purge, 2 minute post-purge, 15 second ignition, 3 trials for ignition, and 60 min lockout.

    d. Direct-sparking sequence shall last through the complete during of the trial for ignition period for guaranteed light-off. Burner shall always be lit at maximum gas flow and combustion airflow for guaranteed light-off. Each burner ignition module shall have LED indicators for troubleshooting and a set of exposed prongs for testing flame indication signal.

    e. Burner shall be of stainless steel construction.

    f. All furnaces shall be controlled by an electronic vernier-type fully modulating control system capable of achieving 80% combustion efficiency over the entire gas firing range of the unit

    g. Burner shall be modulating and have a minimum turn down ratio of 10:1 for natural gas

h. Each furnace heat exchanger shall be made entirely of type 409 stainless steel. he secondary heat exchanger surface shall be made of stainless steel. Heat exchanger is to incorporate primary surface drum and secondary surface tubes in a three pas design. Baffles are to be used to assure proper air distribution on the heat echanger at low air volumes. The primary surface is to be not less than 16 gauge the secondary tubes are to be no greater than 3” in diameter and no less than .055” wall thickness. The front and rear headers as well as the intermediate headers are to be a minimum of 16 gauge. The front and rear collector boxes shall be a minimum of 8" (20.3 cm) deep. The front and rear collector boxes shall overhang the drum and include an integral directional baffle to direct air to cover the entire box as well as the box to tube joint.

i. Each furnace shall include a blocked vent safety airflow switch with high temperature silicone tubing operating off of absolute pressure measured inside of the power-vent blower housing.

j. Each Furnace shall include a power-vent assembly for exhausting flue gases with a type PSC type motor that is securely mounted with rubber vibration isolators and easily accessible/removable for service

k. Each Furnace shall be accessible from both sides of unit

l. Gas train components:

1) Modulating gas valve

2) On/off redundant gas valve

3) Burner

4) Main gas shut-off valve

5) Main gas regulator

6) Two solenoid valves

m. All gas manifold components shall be piped and wired at the factory.

13. Provide painted galvanized intake hood with a 1 inch mesh stainless steel intake birdscreen

14. Provide removable filter section:

a. Provide hinged access door

b. 2 inch pleated MERV 8 filter

c. Casing to match unit casing.

15. Provide galvanized steel insulated discharge air damper installed at the roof penetration with a power open spring close actuator with end switch. The motor-

damper end switch will energize the starter circuit when the damper is in the full open position and returns to a closed position when the unit is shut down. Damper blades to be mounted on friction-free synthetic bearings. Damper edges shall have PVC coated polyester fabric mechanically locked into blade edge. Jamb seals to be flexible metal, compression type

16. Heater housing: Unit shall be enclosed in a completely galvanized sheet steel enclosure with reinforcing members, lifting lugs, burner access plate, and flame and pilot observation port.

17. Fans and drivers: Unit shall be equipped with dynamically and statically balanced in two planes centrifugal blower and motor assembly with V-belt drive.

    a. Heavy duty solid steel shaft. Precision ground and polished.

    b. Provide Forward curved double width double inlet centrifugal blower assembly constructed of G-90 galvanized steel.

    c. Drives are to be mounted outside of the airstream.

    d. Wheel blades shall be securely attached to the wheel inlet ring.

    e. The wheel shall be firmly attached to the fan shaft with set screws and keys.

18. Bearings: Heavy duty, pre lubricated bearings with a minimum L50 life in excess of 200,000 hours. The shall be designed for and individually tested specifically for use in air handling operations.

19. Belts and drives: Belts shall be oil and heat resistant, non static, grip notch type. Drives shall be cast type, precision machined, double groove, keyed and securely attached to fan and motor shaft. Fan operating speed shall be factory set using adjustable pitch motor pulley.

20. Control panel: Unit shall be complete with an UL listed factory pre wired electrical NEMA 3R weather tight control panel/vestibule containing necessary disconnect switches, starter, relays, fuse blocks, and primary flame guard with alarm contacts, automatic pilot valve, electronic modulating control system and interlock system with booth exhaust air fan. Panel to be NEMA 3R rated weather tight construction mounted to exterior of unit. Provide with the following features and safety controls:

    a. 115 volt control transformer, fuses, terminal strip, and motor starter with overload protection. Fan/blower motor to be prewired to the motor starter.

    b. Flame relay: A manual reset of the burner shall be necessary in the event of shutdown due to flame failure.

    c. Audible alarm for flame failure mounted in remote panel

    d. Burner on/off duct thermostat

e. Carbon dioxide detector in ductwork to disable unit on high level alarm

f. Carbon monoxide detector in ductwork to disable unit on high level alarm

g. Clogged filter switch with LED indicator light on the remote panel

h. Exhaust fan interlock

i. Low limit control thermostat, time and relay

j. Magnehelic filter gauge

k. Post purge timer and relay

l. Pre-purge timer and relay

m. Service receptacle

n. Unit-mounted on/off toggle switch

o. Main air-flow safety and combustion air proving switch.

p. Burner and blower service switches.

q. High gas pressure switch

r. Low gas pressure switch

s. Flame roll-out switch

t. Freeze-stat shall be provided with adjustable dials for time and temperature settings to shut down the main blower in case of burner failure

21. Unit mounted control panel to control make-up air unit, paint booth safety interlocks, and booth exhaust fan. Refer to control specification below.

22. Provide remote control panel within the paint room

a. Summer-off-winter switch.

b. Blower on light

c. Burner on light

d. Booth lights on

e. Booth EF status lights

f. Dirty Filter indication light

g. Discharge temperature dial setpoint adjustment

23. Provide extended grease lines: Lubrication lines from blower bearings to common point on unit exterior.

24. Roof curb

    a. 24 inch high, 14 gauge structural steel, provided as a complete welded assembly. Provide 3” of insulation mechanically fastened to inside of curb. Provide cant strip and wood nailer. Secure unit to curb with stainless steel hardware per manufacturers requirements.

25. Electrical:

    a. The control circuit voltage shall be 24V

    b. Provide all required control transformers

    c. Unit to be completely factory wired for single point electrical connection in the field.

    d. All control wiring shall be installed within galvanized conduit.

    e. Wiring within the control enclosure shall be in accordance with the National Electrical Code and the local code

    f. Provide variable frequency drive within unit control cabinet to control the paint booth MAU and EF. VFD to be provided for balancing purposes only. Unit is constant volume.

    g. Unit(s) shall be complete with all items such as relays, starters, switches, safety controls, conduit and wire as previously mentioned, and as required for proper operation.

    h. All factory-mounted controls shall be factory prewired to the unit control panel

    i. Convenience outlet shall be provided on the control board with 120 Vac service.

26. Miscellaneous: Unit shall include filter section, dirty filter indicating system, , ducting, transitions, and other hardware and incidentals necessary for complete and operable installation.

27. Manufacturers

    a. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Bananza

J. Controls: Provide a Pre-wired control panel with NEMA 3R UL listed enclosure mounted within the MAU control cabinet. Unit mounted control panel to control entire system including make-up air unit, paint booth safety interlocks, and booth exhaust fan.

1. All switching and controls shall meet applicable National Electrical Code requirements

2. UL industrial listing

3. MAU and EF to run at 100% OA during spraying operations. System to operate based on remote control panel selector switch:

   a. Summer position

      1) EF to be energized, MAU heating burner to be disabled and blower to be energized.

   b. Off position

      1) MAU and EF to be de-energized

   c. Winter position

      1) EF to be energized, MAU heating burner to modulate to maintain discharge temperature and blower to be energized

      2) Discharge Temp Control: For building exhaust-air replacement to maintain a constant discharge temperature of supply air of 70 deg F (adj). The burner flame modulates to compensate for outdoor temperatures. Discharge temperature setpoint to be limited to a maximum of 110 deg F.

4. Provide ¾" 3- way solenoid valve to prevent spraying in booth when fans are off or light tube access door is opened per NFPA-33 requirements. Compressed air between valve and the spray equipment to be vented out when exhaust is shut off

5. Automatic safety shut-down system: Provide a safety shut down system with audible alarm that automatically turns off compressed air to spray booth paint gun supply line when paint accumulation in exhaust air filters reaches an adjustable preset load point and whenever exhaust fan stops running to prevent buildup of fumes to hazardous levels.

6. Dwyer Mark II Manometer (Required per NFPA-33 Fire Code to monitor paint over spray build up on exhaust filters) with automatic dirty filter shut down with alarm.

K. Utilities Available:

1. Electrical:

   a. Single point connection to controller: 480 VAC, 3 phase. 30 amp breaker. Controller to power exhaust fan, heated make-up air unit, and lighting fixtures. Controller to be provided with all required transformers, relays, safety circuiting, control circuiting, programming, and contacts to make a complete and operable system.

2. Natural gas: 1,215,000 BTU/hour at 7 to 14 inches.

L. All power and control wiring and conduit between the booth control panel and the associated equipment is provided and installed by the booth manufacturer, this includes lights, make-up air unit, exhaust fan, solenoid valve, safety switches, manometer pressure switches, etc.

M. Booth manufacturer to provide required ductwork to and from booth attached to make-up air unit and exhaust fan.

N. Finish: Prepare interior galvanized surfaces as required, prime and paint with a semi-gloss white enamel finish. Exterior galvanized surfaces shall be left unfinished

2.36 PERSONNEL FALL PROTECTION UNIT
Equipment Mark Number 6235

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Rigid Lifelines

B. Capacities and Dimensions:

1. Pre-engineered track system:

a. Minimum capacity: 2200 pounds, nominal certified for two user.

b. Minimum length: 45’

c. Three support hangers located in the middle and maximum of 6’ from each end

d. Fall protection track to have a minimum yield strength of 50,000 psi

e. Minimum yield strength of truss structure supporting the fall protection track shall be 42,000 psi

2. Self-retracting lifeline:

a. Capacity: 310 pounds, maximum.

b. Maximum arresting force: 900 pounds

c. Working length: 11 feet.

d. Webbing width: 1 inch.

e. Weight: 2.8 pounds, nominal.

3. Full body harness:

a. Capacity: 310 pounds, maximum.

b. D-ring capacity: 5000 pounds, nominal.

c. Weight: 1.71 pounds, nominal.

C. Features and Construction:

1. Operation: Personnel fall protection shall come complete with self-retracting lifeline, pre-engineered track system, and full body harness.

2. The fall protection system shall be manufactured in an ISO 9001 facility. All welders shall be AWS certified welders. Manufacturing facility must also be an AWS certified welding facility with an AWS certified Quality Management System

3. The manufacturer shall be an experienced manufacturer of fall protection equipment with at least five years of experience manufacturing full fall protection systems

4. All components used in the fall protection system shall be fully tested and documented to be in compliance with both OSHA 1910.66 App C and ANSI Z359 V2.0.

5. The manufacturer of the fall protection system shall be a member in good standing with the International Society of Fall Protection [ISFP] and American Society of Safety Engineers [ASSE].

6. Pre-engineered truss track system:

a. Construction: A500B tube steel

b. Hangers to be provided and engineered by the track system manufacturer. Hangers to be designed to accommodate suspended installation including installation of kickers to prevent swaying.

c. All trusses to be fully welded to the track and top cord. Hangers and stops to be bolted to/through the track such that no welding is required for installation.

d. Utilizes rotating eye trolley with friction brakes that engage during fall to prevent worker from drifting

e. Track profile design to ensure wheel protection, accurate alignment with minimum friction, and minimum maintenance “self” cleaning profile. All fall protection tracks shall have full contact flange loading surfaces [flat] to decrease flange and wheel loads during a fall event.

f. End stop bumpers through bolted to the track

g. All components to be painted with yellow paint

7. Self-retracting lifeline: Self-retracting lifeline shall be constructed of 1 inch nylon webbing with a sewn in load indicator and transparent plastic casing for visual

inspection of internal components. Lifeline shall allow user freedom of movement in all directions through the utilization of a 360 degree swivel. Life shall arrest falls immediately through the use of a cable locking speed sensing brake system and comply with OSHA 1926 and ANSI Z359.1 standards.

a. Construction: lightweight aluminum housing with stainless steel working components.

b. Provide with steel snap hook

c. 3,600 pound rated gate

8. Full body harness: Full body harness shall be designed with three points of adjustment and include a sliding back drop forged proof tested D-ring to provide shock absorption during falls, a sub-pelvic strap to provide greater support while arresting a fall, and parachute buckles to ensure 100 percent closure. Harness shall be multicolored for ease of donning and constructed of 1-3/4 inch nylon straps and include sewn-in load indicators to provide immediate visual inspection points. Harness shall comply with OSHA 1926 and meet ANSI Z359.1-1998 Standard.

D. Delegated design: Contractor is responsible for coordinating all fall restraint capacities and dimensions with owner safety personnel prior to ordering. Provide written approval and verification that system complies with owner safety standards , OSHA, and ANSI regulations.

2.37 PAINT GUN WASHER
Equipment Mark Number: 6650

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Astro Tool

B. Capacities and Dimensions:

1. Minimum 2.5 gallons cleaning fluid tank

C. Features and Construction:

1. Designed for use with waterborne and solvent based paints spray guns

2. Pump-less, pneumatically operated

3. One gun and one cup capacity

4. Used cleaning fluid to be easily disposed of via drain valve

5. Pre-assembled and ready for use

6. Equipped with auto stop timer, safety shut-off valve, and air regulator

7. Provide steel stand

8. Stainless steel lid with auto shut-off switch

D. Utilities Available:

1. Air: 1/4 inch NPT

E. Finish: Durable enamel in manufacturer's standard color.

2.38 SHAKER, PAINT
Equipment Mark Number: 6670

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Midwest Mixing, Incorporated.

B. Capacities and Dimensions:

1. Paint can capacity: Single one, two, and five gallon cans or one case of four, one gallon cans.

C. Features and Construction:

1. Can clamp: Threaded top clamp mechanism for sealing and locking cans to be shaken shall incorporate recessed bottom clamp to minimize slippage.

2. Bearings: Unit shall have permanently lubricated ball bearings and eccentric mechanism.

3. Drive: Mechanism shall be completely enclosed in a bolted sheet steel housing.

4. Motor: Explosion proof motor and 0-30 minute timer.

5. Frame: Heavy steel channel frame shall be drilled for floor, bench, or pedestal mounting.

Can holder will rotate through 360 degrees and lock in any position for shaking operation.

6. Power cord: Unit shall be provided with a minimum 10-foot power cord and plug compatible with facility's receptacles

D. Utilities Available:

1. Electrical: 120 VAC, 1 phase, 1/3 Hp.

E. Finish: Durable enamel in manufacturer's standard color.

2.39 DRAIN PAN, PORTABLE, USED OIL
Equipment Mark Number: 8165

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Graco inc.

B. Capacities and Dimensions:

1. Minimum tank capacity: 25 gallons.

2. Drain bowl height adjustment, nominal: 45 inches to 69 inches.

3. Operating temperature: 30 degrees to 105 degrees

C. Features and Construction:

1. Construction: Polyethylene tank with used filter tray, tool holders, and sight gauge..

2. Two large wheels shall be fixed and the other two shall be swivel casters.

3. Drain bowl assembly: A vertically adjustable drain bowl assembly with lock screw and removable filter screen..

4. Hose site gauge: Permanent clear hose site gauge shows you when to stop filling.

D. Finish: Durable enamel in manufacturer's standard color.

2.40 DRAIN PAN, PORTABLE, USED COOLANT
Equipment Mark Number: 8166

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Graco inc

B. Capacities and Dimensions:

1. Minimum tank capacity: 25 gallons.

2. Drain bowl height adjustment, nominal: 45 inches to 69 inches.

3. Operating temperature: 30 degrees to 105 degrees

C. Features and Construction:

1. Construction: Polyethylene tank with used filter tray, tool holders, and sight gauge.

2. Two large wheels shall be fixed and the other two shall be swivel casters.

3. Drain bowl assembly: A vertically adjustable drain bowl assembly with lock screw and removable filter screen..

4. Hose site gauge: Permanent clear hose site gauge shows you when to stop filling.

D. Finish: Durable enamel in manufacturer's standard color.

2.41 OIL FILTER PRESS
Equipment Mark Number: 8492

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Gray Automotive Products Company.

B. Capacities and Dimensions:

1. Minimum crushing force: up to 22,000 pounds.

2. Cycle time: 20 seconds.

3. Filter crush: 80 percent.

4. Minimum chamber size:

a. Width: 8 inches.

b. Depth: 10 inches.

c. Height: 16-1/4 inches.

C. Features and Construction:

1. Filter Capacity: Unit must be capable of crushing one 8-inch diameter heavy-duty filter or 4 automobile filters.

2. Crusher: Crusher shall use air bag crushing technology for even pressure distribution in crushing chamber.

3. Safety interlock: Press shall be equipped with dual safety interlock to prevent operation when the door is open.

4. Air inlet regulator/filter: Unit must have factory supplied air regulator/filter with 3/8 inch NPT air inlet fitting.

5. Method for waste oil storage: Unit shall be able to accommodate a waste oil accumulation tank or reservoir and connect to it by means of 3/4 inch NPT drain outlet fitting.

6. Shut off: Unit shall automatically shut off after each cycle.

D. Accessories:

1. Round steel drum, 55 gallon, ribbed, with removable top cover, to be placed under the oil filter crusher for the purposes of capturing drained oil, one each.

2. Flexible clear hose, 24 inches long, securely attached to oil drain fitting at base of the oil filter crusher, allowing oil to drain directly from the crusher to the drum beneath, one each.

3. Steel mesh or grate, cut to fit securely over the 55 gallon drum opening and capable of supporting the weight of up to six large oil filters, completely full, with out bending or bowing.

4. Round steel drum, 55 gallon, ribbed, with removable top cover, to be placed next to the oil filter crusher for the purposes of depositing crushed oil filters, one each.

5. Drum dolly with 600 pound capacity and maximum height of 3-1/2 inches to be attached to steel drums, Hamilton product DM232 or equal, two each.

E. Utilities Available:

1. Air: 1/4 inch, 130 PSI, 44 CFM.

F. Finish: Durable powder coat in manufacturer's standard color. All completed components shall be acid dipped prior to power coating.

2.42 FILTER, ELECTROSTATIC
Equipment Mark Number: 9350

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Plymovent Corporation.

B. Capacities and Dimensions:

1. Airflow: 883 CFM, nominal.

2. Motor: 1 HP.

3. Maximum noise level: 70 dBa, maximum.

4. Coverage: Arc of 360 degrees with 10-foot radius.

C. Features and Construction:

1. Filter unit: Unit shall be constructed of steel and house filters, impeller, and a TEFC model 110 volt single phase fan motor with spark resistant fan. Unit shall be equipped with a top hinged access door for service and filter replacement with a filter protection shield below the air inlet to eliminate damage to the filter elements. Unit shall be equipped with four 4 inch swivel type lockable casters and a three-prong plug 16-foot power cord.

2. Filtration: Unit shall utilize a multi stage filtration system with the first stage being a washable 3/4 inch deep aluminum mesh pre filter, the second being an electrostatic ionizer with spring loaded stainless steel wires charged to 12,000 volts, and the third being a 176 square foot collection cell charged to 6000 volts with a filtering efficiency of 98 to 99 percent for particulates down to .000005 mm. The unit shall have the capability to house an active carbon filter to absorb unpleasant odors.

3. Extraction arm assembly: Extraction arm, Model# KUA-3-S shall be 6-1/4 inches in diameter, ball bearing collar mounted, and capable of tilting 110 degrees and rotating 360 degrees with a vertical reach of 10 feet and a horizontal circular reach of approximately 19 feet 6 inches in diameter. The arm shall have manual ratcheting and locking airflow damper included in the ring handle, five adjustable friction joints, three friction links, and constructed of black polyemide flex hose covering internal plated steel supports.

4. Filter monitoring system: Unit shall have a monitoring system to alert operator of inadequate filtration system performance. When this occurs, a yellow warning light and an audible alarm shall activate for 20 seconds. After this period, a red light shall activate and the filter fan shall be automatically disabled. The operator must then clean the collection and ionization cells before restarting the filter system.

D. Controls: ON/OFF power switch shall be located on the side panel below steering handle.

E. Accessories:

1. Hood mounted, 24 volt, 20 watt halogen lamp: Model No. HL-20/24-160 with cord and 115/24 volt transformer, one each.

2. Activated Carbon Filter: Model No. CF-002.

3. Replacement pre-filter: Model No. FF-3000, one each

4. Replacement Collection Cell: Model No. EC-3000

5. Replacement Ionizing Cell: Model No. IM-3000

F. Utilities Available: 120 VAC, 1 HP.

G. Finish: Powder coated in manufacturers standard color.

2.43 SPILL KIT
Equipment Mark Number: 9985

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by New Pig.

B. General Description

1. Spill kit contains an assortment of products for absorbing only oil

C. Capacity and Dimensions

1. Absorbency: up to 39 gallons

D. Features and Construction:

1. Chemical and water resistant polyethylene 65-gallon overpack- treated with UV inhibitors

2. Easy-open, threaded lid

3. Absorbents are packed in protective baskets with a lid for long-term protection against UV degradation; lift out baskets provide easy, organized access to contents for quick spill response

4. Empty overpack can be used as a low-cost shipping container for used-absorbents

5. Booms/socks and pads to meet NFPA 99standards for static decay

6. Provide UV-resistant overpack spill kit cover to accommodate outdoor use

7. UN certified

8. Construction

a. Overpack: Polyethylene

b. Booms: Co-Poly outer skin and Polypropylene inner skin and filler

c. Polypropylene inner skin and filler

d. Mats: Polypropylene

9. Contents included:

a. x2- 5” x 10’ oil only booms

b. x9- 3” x 10’ oil only booms

c. x40 mat absorbents

d. x10- temporary disposal bags and ties

e. x6- tamperproof labels

f. x1- instruction manual

PART 3 - EXECUTION

3.1 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.

B. Inspect delivered equipment for damage from shipping and exposure to weather.

C. Compare delivered equipment with packing lists and specifications to assure receipt of all items.

3.2 INSTALLATION

A. Perform work under direct supervision of Foreman or Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect.

B. Install equipment in accordance with plans, shop drawings and manufacturer's instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level, plumb and at right angles to adjacent work.

2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.

3. Anchorage: Attach equipment securely to floor, as directed by Architect, to prevent damage resulting from inadequate fastening. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.

4. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.3 TESTING

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to start-up inspect, test, and adjust components, assemblies, and equipment installations, including connections, check operation of the equipment and components for operation and performance as specified and examine the finish for damage. Provide report in writing that the installation meets the requirements and shall include information concerning minor adjustments and minor repairs, which may be required before final acceptance by the Owner.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment

B. Prepare test and inspection reports

C. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with all specified features in the presence of the Architect using acceptance procedures provided by the manufacturer.

3.4 CLEANUP

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing or installation debris from job site.

D. Notify Architect for acceptance inspection.

3.5 TRAINING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment

B. Direct the technical representative to provide specified hours of training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.

1. BUFFER/GRINDER, 8 INCH, WITH DUST COLLECTOR
Equipment Mark Number: 2080
Hours Required: 1

2. ABRASIVE BLASTING CABINET
Equipment Mark Number: 2270
Hours Required: 1

3. BUS TIRE MOUNTER/DEMOUNTER
Equipment Mark Number: 2450
Hours Required: 1

4. PARATRANSIT TIRE MOUNTER/DEMOUNTER
Equipment Mark Number: 2451
Hours Required: 1

5. PRESS ELECTRIC/HYDRAULIC
Equipment Mark Number: 2535
Hours Required: 1

6. PORTABLE BRAKE LATHE
Equipment Mark Number: 2674
Hours Required: 1

7. LATHE
Equipment Mark Number: 2680
Hours Required: 1

8. SCRUBBER, FLOOR BATTERY, WALK BEHIND
Equipment Mark Number: 3357
Hours Required: 1

9. TANK, PARTS CLEANER
Equipment Mark Number: 3560
Hours Required: 1

10. WASHER, PARTS, SMALL
Equipment Mark Number: 3785
Hours Required: 1

11. WHEEL BALANCER, ELECTRONIC, BUS
Equipment Mark Number: 4912
Hours Required: 1

12. WHEEL BALANCER, ELECTRONIC, PARATRANSIT
Equipment Mark Number: 4913
Hours Required: 1

13. ALIGNMENT MACHINE
Equipment Mark Number: 5705
Hours Required: 1

14. OPEN FACED PAINT BOOTH
Equipment Mark Number: 6108
Hours Required: 4

15. PERSONNEL FALL PROTECTION UNIT
Equipment Mark Number 6235
Hours Required: 2

16. PRESS, OIL FILTER, PNEUMATIC
Equipment Mark Number: 8492
Hours Required: 1

17. FILTER, ELCTROSTATIC, PORTABLE
Equipment Mark Number: 9350
Hours required: 1

C. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

D. Provide a Windows compatible movie file format recording on DVD disk of the training session. The DVD training movie can be of a live session or a produced training video.

END OF SECTION 115100

SECTION 115110 – CARBON MONOXIDE EXHAUST SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMNTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes centrifugal fans, hose reels, exhaust adaptors flexible tubing/hose, and other components necessary for a vehicle carbon monoxide exhaust system.

B. Related section include the following:

1. Division 23 Section "Metal Ducts" for metal duct work not specified in this section.
2. Division 23 Section "Testing, Adjusting and Balancing" for testing, adjusting and balancing requirements not specified in this section.
3. Division 26 Section for power supply routing, field installed disconnects, electrical devices motor controllers.

C. Equipment items as listed below by Equipment Mark Number:

1. REEL, VEHICLE EXHAUST
Equipment Mark Number: 3304
Submittal requirements: PD, OM, SD, T

D. Provide roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.
1. Coordinate and verify all electrical and utility connections with all trades prior to equipment ordering and purchase.

E. Piping, wiring, and switching between equipment and utilities

1.3 QUALITY ASSURANCE

A. Experience: Equipment shall be produced by a manufacturer of established reputation with a minimum of five years experience supplying specified equipment.

B. Each product shall be provided by a single manufacturer.

C. All components shall be factory tested and documented to operate as a complete system

D. Manufacturer's Representative: The manufacturer authorized representative shall be factory trained and certified personnel providing service, startup, and quality control field labor for the project from their local office.

1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out and start up.
2. Training: Provide technical representative to train Owner's maintenance personnel in operation and maintenance of specified equipment

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

G. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards

1.4 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base air ratings on sea-level conditions.

B. Operating Limits: Classify according to AMCA 99.

C. System Load: The system must operate satisfactorily with one (1) 425 HP CNG operated vehicles attached and running at idle.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. Refer to above submittal requirements. The following abbreviations are used to indentify submittals required:
1. PD- Product Data
2. SD- Shop drawings
3. OM- Operation and Maintenance manual
4. T- Training of owners personnel on specific equipment items

C. Produce Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical requirements, and provided accessories:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material gages.
5. Flexible tube/hose data, pressure class, heat range, material, and performance.
6. Hose reel data, construction, and operation
7. Controls
8. Adaptors, and other miscellaneous equipment.

D. Shop drawings and schematics detailing fabrication, installation, piping layout, materials and finishes, system interconnections, and utility connections of equipment assemblies. Indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection

1.6 INFORMATION SUBMITTALS

A. Delegated-Design Submittal: For unit hanger support frame for equipment to comply with performance requirements and design criteria, including analysis data signed and sealed by a qualified Connecticut professional engineer responsible for their preparation.

B. Factory tests and inspection reports prior to shipping.

C. Field test and start-up reports, indicating and interpreting test results relative to compliance with specified requirements, for information.

D. Certificates: For certification required in "Quality Assurance" Article

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For the equipment identified to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents
   1. Nozzles: Provide two (2) extra nozzles
   2. Telescopic lifting pole: Provide two (2) extra lifting poles
   3. Contractor: Provide two (2) extra contactors associated with automatic fan start/stop controls.
   4. Hose: Provide one (1) extra high temp and low temp hose assembly

1.9 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, function and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough, or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.

D. All parts shall be readily available locally in the United States.

E. Any units or parts which prove defective during the warranty period will be replaced with OEM parts and transportation prepaid

1.10 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid, dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Mark Number of this specification.

C. Provide equipment and materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

1.11 LABELING

A. Nameplate: Manufacturer shall securely attach in a prominent location on each major item of equipment a non-corrosive nameplate with stamped figures showing manufacturer's name, address, model number, serial number and pertinent utility or operating data.

B. Lifting capacity shall be painted with letters and numbers 3 inches high Minimum on both sides of lifting mast assembly.

C. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (U.L.), or other National Recognized Testing Laboratory (NRTL), in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant

1.12 COORDINATION

A. Coordinate size and location of structural-steel support members.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Nederman.

2.2 MANUFACTURED UNITS

A. Description:

   1. Centrifugal Fan: Factory-fabricated, -assembled, -tested, and -finished, direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor drive assembly, mounting bracket for direct mount to hose reel assembly.
   2. Hose Reel: Factory-fabricated, -assembled, - tested, and –finished, hose reel consisting of welded frame, end plate, rotating cylinder, high temperature flexible hose/tubing, motorized operated, pendant switch, nozzles, and fan switch.

2.3 CENTRIFUGAL FANS

A. Capacity:
   1. Motor: 2 Hp
   2. Air volume: 800 cfm at 7.3” s.p.

B. Housing:

   1. Materials and Fabrication: Formed and reinforced steel housing.

      a. Outlet flange.
      b. Provide direct mount flange that will allow it to be mounted to the motorized hose reel.

   2. Finish: Epoxipolyester powder paint
      a. Color: Manufacturer’s standard

C. Wheels:

   1. Impeller: Radial tip blades

   2. Construction: Cast aluminum

   3. Fan wheel shall be statically and dynamically balanced before fan assembly. Wheels shall be balanced by means of material removal.

   4. Finish: Epoxipolyester powder paint
   5. Color: Manufacturer’s standard

D. Shafts:

   1. Statically and dynamically balanced and selected for continuous operation and maximum rated fan speed and motor horsepower, with final alignment and drive adjustment made after installation.
   2. Turned, ground, and polished hot-rolled steel with keyway. Ship with a rust inhibitive asphatic protective coating.
   3. Designed to operate at no more than 70% of first critical speed at top of fan’s speed range.

E. Bearings:

   1. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball high temperature, bearings.

      a. Ball-Bearing Rating Life: ABMA 9, L_{10} of 50,000 hours.

F. Accessories:

   1. Companion Flange: Galvanized steel, for duct connections.
      a. Fan outlet shall be ducted to the outside of the building as shown on drawings with minimum of 22 gauge galvanized ductwork and sealed per SMACNA guidelines.

G. Motors:

1. Refer to Division 23 Section “Motors and Variable Frequency Drives” for general requirements for factory-installed motors.
2. Class F insulation.
3. High Efficiency TEFC type suitable for indoor and outdoor installations.
4. Enclosure Type: Open dripproof.
5. Direct Drive

H. Source Quality Control:

1. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 211, “Laboratory Methods of Testing Fans for Rating.” Label fan(s) with the AMCA – Certified Rating Seal.
2. Factory Test: Factory run test each fan before shipping. Provide test report to architect prior to fan installation.

2.4 HOSE REEL(S)

A. General: The hose reel(s) are motorized and intended for the removal of carbon monoxide exhaust fume from all types of vehicles. The hose will be unwound by an electric drive motor from the reel and will lock into place at the desired location. The hose will withdraw after use by the electric drive motor. Contactor switch located on the reel will automatically start the exhaust fan when reel is extended.

B. Frame:

1. Zinc coated steel tube with 12 gauge and plates.
2. The reel shall be provided with two adjustable mounting brackets that will allow for ceiling or wall mount

C. Drum:

1. The drum shall consist of aluminum zinc plated steel, bolted to two composite ends. Inside the drum provide a flexible 6.25 inch aluminum tube connecting the swivel to the drum adapter. The drum adapter is to be cast aluminum and will connect to 6 inch diameter hose
2. The drum shall be capable of accommodating 24′ of 6” tube/hose.
3. Lifting capacity: 65 lbs
4. The drum shall have a hose guide to guide the tube/hose during the first revolution of the drum.
5. A flexible 6.25 inch aluminum tube 12 inches long shall be provided to connect the reel to the fan.
6. Motor to turn via a planetary gear and drum end sprocket gear

D. Controls
1. The motorized reel will include a drive unit and control box containing a circuit board with integrated upper and lower limit switches that will not require a hose stop or mechanical switch.

2. Provide 24V two button pendant station switch to control hose up and down. Station switch to be wired to the motorized hose reel.
3. Circuit board to include relay for fan operation and micro switch operation. Control box to contain contactor and 24V transformer connected to the hose reel..
4. Provide arm with indicator LEDs showing reel status
5. Provide 3-way remote mounted over ride switch with on/off/ auto selection. Switch to be remote mounted to column. Provide required conduit and wiring from remote mount switch to control box. When switch is in on position fan to run continuously. When switch is off position fan to be disabled. When over ride switch is in auto fan to automatically start when hose is lowered and shut off when hose is raised.

2.5 TUBE/HOSE:

A. The hose shall be constructed of high temperature fabric with an external steel helix. The lower 8 feet will handle up to 1380º F and continuous temperatures of 1200º F. The upper 16 feet of hose will handle up to 660º F and continuous temperatures of 575º F. The two hoses will be joined with a steel 6” to 6” hose connector.

B. Features and constructions:
1. Size range: 3” ID through 36” ID
2. Two layers of special high temperature asbestos free material with heat stabilizers and woven stainless steel wire with galvanized steel external helix.
3. Color: Red
4. Extreme temperature resistance
5. Flame resistance
6. Silicone free
7. Excellent flexibility
8. Tight bend radius

C. Band clamps
1. Stainless steel
2. Size range: 1.5” through 36”
3. Designed to bridge helical support
4. Color- silver
5. Positive attachment and 360 degree seal
6. High strength reinforced stainless bridge section

D. Tube/Hose shall be 6″ diameter on all hose reels.

E. Provide sufficient tube/hose such that when the draw is fully retracted the tube/hose will extend from the hose reel to 6′0″ (adj.) above finished floor.

2.6 SYSTEM ACCESSORIES

A. Exhaust Connections:

1. Provide required nozzles to accommodate bus tailpipe configuration. Coordinate with owner prior to ordering.

a. The 22 gauge stainless steel nozzle shall have a locking clamp and lifting sleeve. The nozzle will connect to 6” diameter hose and have an 8” opening

B. A telescopic lifting pole shall be provided with the nozzle. The lifting pole shall be capable of extending to 10 feet

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install centrifugal fans and hose reels level and plumb.

B. Support fans using spring isolators support furnished with fan.

1. Install as per manufacturers instructions.

C. Support suspended hose reels from structure using galvanized steel Uni-strut. Refer to details on drawings.

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment.”

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.

B. Install ducts adjacent to fans and hose reels to allow service and maintenance.

C. Ground equipment.

D. Tighten electrical connectors and terminals according to manufacturer’s published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 INSTALLATION

A. Perform work under direct supervision of Foreman or Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect.

B. Install equipment in accordance with plans, shop drawings and manufacturer's instructions:
1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level, plumb and at right angles to adjacent work.
2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.

3. Anchorage: Attach equipment securely to floor, as directed by Architect, to prevent damage resulting from inadequate fastening. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.
4. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains

3.4 TESTING

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to start-up inspect, test, and adjust components, assemblies, and equipment installations, including connections, check operation of the equipment and components for operation and performance as specified and examine the finish for damage. Provide report in writing that the installation meets the requirements and shall include information concerning minor adjustments and minor repairs, which may be required before final acceptance by the Owner

B. Equipment Startup Checks:

   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
   3. Verify that cleaning and adjusting are complete.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
   5. Verify lubrication for bearings and other moving parts.
   6. Verify that fan operates when hose reel is extended.
   7. Verify all connections are made per manufacturers requirements.

C. Starting Procedures:

   1. Energize motor and adjust fan to indicated rpm.
   2. Measure and record motor voltage and amperage.

D. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

E. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

G. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with all specified features in the presence of the Architect using acceptance procedures provided by the manufacturer

H. Prepare test and inspection reports

3.5 ADJUSTING

A. Lubricate bearings.

3.6 CLEANUP

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing or installation debris from job site.

D. Notify Architect for acceptance inspection.

3.7 TRAINING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment

B. Direct the technical representative to provide specified hours of training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained

1. REEL, VEHICLE EXHAUST
   Equipment Mark Number: 3304
   Hours Required: 1

C. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

D. Provide a Windows compatible movie file format recording on DVD disk of the training session. The DVD training movie can be of a live session or a produced training video

END OF SECTION 115110

SECTION 115213 - PROJECTION SCREENS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wall Mounted Projection Screen/Markerboard.

1.3 DEFINITIONS

A. Gain: Ratio of light reflected from screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per SMPTE RP 94.

B. Half-Gain Angle: The angle, measured from the axis of the screen surface to the most central position on a perpendicular plane through the horizontal centerline of the screen where the gain is half of the peak gain.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

C. Samples for Initial Selection: For finishes of surface-mounted screen frames.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Projection Screens to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Environmental Limitations: Do not deliver or install projection screens until spaces are enclosed and weather-tight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 COORDINATION

A. Coordinate layout and installation of projection screens with adjacent construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Projection Screens: Obtain projection screens from single manufacturer. Obtain accessories, including necessary mounting hardware, from screen manufacturer.

2.2 PROJECTION SCREENS

A. General: Manufacturer's standard components necessary for a complete installation.

B. Wall Mounted Projection Screen and Markerboard: Units designed and fabricated for surface mounting on wall . Screen frame fabricated from aluminum, 1 ½ inch wide x 7/8 inch deep. Screen surface to consist of write/ erase projection film permanently adhered to tempered hardboard to allow use of dry erase markers and interactive stylus. Projection surface to have a gain of 2.5 and a viewing half angle of 25 degrees. Provide aluminum tray at bottom of frame and manufacturers standard wall mounting bracket.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Da-Lite Screen Company; Idea Screen.

a. Size: 45 inches high x 69 inches wide.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install projection screens at locations indicated to comply with screen manufacturer's written instructions.

B. Install projection screens with screen frames in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a screen with vertical edges plumb and viewing surface flat.

END OF SECTION 115213

SECTION 115400- FARE COLLECTION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED SECTIONS

The General Provisions of the Contract, including General and Special Conditions, apply to the Work in this Section.

1.2 WORK INCLUDED

A. Equipment items as listed below by Equipment Mark Number:

1. VAULT/RECEIVER, FAREBOX, MOBILE BIN
Equipment Mark Number: 7800
PD, OM, T

2. DATA COLLECTION AND REPORTING SYSTEM, FAREBOX
Equipment Mark Number: 7820
PD, SD, OM, T

B. Roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.

C. Piping, wiring, and switching between equipment and utilities.

1.3 QUALITY ASSURANCE

A. Farebox Data collection Manufacturer shall provide the engineering, installation, calibration, wiring, conduit, hardware, software programming, and check-out necessary to for a complete and fully operational system..

B. All components shall be factory tested and documented to operate as a complete system

C. Manufacturer's Representative: The manufacturer authorized representative shall be factory trained and certified personnel providing service, startup, and quality control field labor for the project from their local office.

1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out and start up.

2. Training: Provide technical representative to train Owner's maintenance personnel in operation and maintenance of specified equipment.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

F. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. Refer to above submittal requirements. The following abbreviations are used to indentify submittals required:

1. PD- Product Data

2. SD- Shop drawings

3. OM- Operation and Maintenance manual

4. T- Training of owners personnel on specific equipment items

C. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical requirements, wiring diagrams, and provided accessories.

1. Restrict submitted material to pertinent data. For instance, do not include manufacturer's complete catalog when pertinent information is contained on a single page.

D. Shop drawings and schematics detailing fabrication, installation, piping layout, materials and finishes, system interconnections, and utility connections of equipment assemblies. Indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection

1.5 INFORMATION SUBMITTALS

A. Factory tests and inspection reports prior to shipping.

B. Field test and start-up reports, indicating and interpreting test results relative to compliance with specified requirements, for information

C. Certificates: For certification required in "Quality Assurance" Article

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For the equipment identified to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, function and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough, or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.

D. All parts shall be readily available locally in the United States.

E. Any units or parts which prove defective during the warranty period will be replaced with OEM parts and transportation prepaid.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid, dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Mark Number of this specification.

C. Provide equipment and materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

1.9 LABELING

A. Nameplate: Manufacturer shall securely attach in a prominent location on each major item of equipment a non-corrosive nameplate with stamped figures showing manufacturer's name, address, model number, serial number and pertinent utility or operating data.

B. Lifting capacity shall be painted with letters and numbers 3 inches high Minimum on both sides of lifting mast assembly.

C. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (U.L.), or other National Recognized Testing Laboratory (NRTL), in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant.

PART 2 – PRODUCTS

2.1 VAULT/RECEIVER, FAREBOX, MOBILE BIN
Equipment Mark Number: 7800

A. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by GFI Genfare.

B. General Description: The mobile vault shall be designed to be placed in the bus service area and consist of a cashbox receiver on top of a mobile bin housing and a separate mobile bin on wheels that fits inside the housing. Coins and bills will be transferred from cashboxes in a rapid, secure manner to a mobile vault where bills and coins are kept segregated. The vault shall feature an interlock system that protects collected revenues

from theft by requiring a secure sequence of events and conditions. In this sequence, the receiver accepts the locked cashbox and, if secure conditions are met, opens the cashbox while inside the receiver, empties the contents into a separate coin and bill compartments in the vault below and then closes and locks the cashbox.

C. Capacities and Dimensions:

1. Maximum overall dimensions:

a. Width: 38 inches.

b. Depth: 41 inches.

c. Height: 66 inches.

2. Maximum mobile bin dimensions:

a. Width: 30 inches.

b. Depth: 37 inches.

c. Height: 31 inches.

3. Storage capacity:

a. Coins: $ 12500.

b. Bills: $12500.

D. Features and Construction:

1. Environmental:

a. Ambient temperature: 0 degrees F to 120 degrees F

b. Surface heated by direct sunlight: +150 degrees F

c. Humidity range 5% to 90% RH

d. Precipitation: driving rain, exterior condensate and icing effects, wind gusts up to 50 mph.

e. Weather, oil, and diesel fuel resistant

2. Stand-alone structure, no additional supports or overhead enclosure required.

3. Vault: Vault shall be constructed of welded and ground 1/8 inch non-corroding plate steel. The front surface shall have been cleaned, prepared, and painted with weather resistant enamel, door and interior shall be made of stainless steel to deter corrosion and wear. Doors on vault shall be rigid with heavy-duty hinges and security locks.

4. Cashbox receiver: Cashbox receiver shall be located at the top of the vault for gravity assisted revenue transfer. Unit shall be of stainless steel and mechanically operated for positive control. The internal mechanism shall be operated by a crank and allow the contents to transfer securely into dual compartments in the vault below. Elements of receiver shall be integral and all engagements an/or alignments shall be positive and automatic. Receiver shall be equipped with a locking device to restrain movement of operating crank when the receiver is not in use.5-digit mechanical counter in receiver shows number of revenue transfer cycle.

5. Mobile bin: Mobile bin shall be configured with two separate compartments, one for coins and one for bills. The mobile unit must have two large revenue discharge doors with security locks, one for coins and one for bills. Coins shall be discharged from the bin by gravity using sloped stainless steel bottoms surfaces. Discharge door and openings shall be securely designed to prevent unwanted exposure of revenue. Bin shall be equipped with heavy-duty two fixed and two swivel casters. The bottom of the bin must be reinforced to inhabit deformation while being moved with forklift. Mobile bin unit must not exceed 32 inches in width to allow unit to pass through 36 inch doors. Mechanical interlocks sense

6. Receiver indicators: Indicators shall be provided adjacent to the receiver door to signify a ready condition and a process condition. Indicators shall be patches of color that appear in a small window and shall not require electricity.

7. Discharge: Unit shall have built-in time delay assist to allow for gravity discharge of bills and coins and must have secure interlocks to allow for sequence and event controlled operation.

8. Coin access door: Unit access door shall be in captive track and secured by security lock.

9. Bill access door: Bill access door shall have a continuous hinge and be secured with security lock.

E. Accessories: Vault/Cashbox Electronic Monitoring System.

F. Utilities: Vaults do not require AC power.

G. Finish: Polyurethane high visibility orange.

2.2 DATA COLLECTION AND REPORTING SYSTEM, FAREBOX

Equipment Mark Number: 7820

A. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by GFI Genfare

B. General Description:

1. Data collection and reporting system (DCRS) shall communicate with the fareboxes to extract transaction and event data and download operating parameters and related information. The DCRS shall communicate with the vault to extract cashbox identification from cashboxes inserted in the receiver. The DCRS shall provide **three** data probes linked to an IBM PC-compatible computer capable of extracting and storing data from the bus fareboxes during routine servicing. The data system shall be capable of generating comprehensive management reports for use by the Owner.

2. System equipment: Equipment shall include but not be limited to the following:

   a. Two data probes, each with junction box, probe holder, lock boxes to secure the probe when not in use, interconnecting cabling, and an isolation box for transient voltage protection.

   b. Computer system consisting of an IBM PC-compatible computer with display and keyboard, laser printer, and other hardware and software. **Computer equipment to be provided by Owner. **

   c. Uninterruptible power supply (UPS) for computer system, isolation box, and cashbox I.D. computer. **UPS to be provided by Owner.**

   d. Data collection software and single site use license.

   e. Cashbox ID computer.

   f. Miscellaneous hardware as required for a complete and operable installation.

C. Features and Construction:

1. Data probe: A data probe shall be provided to permit bi-directional communications between the farebox and the data system by means of infrared technology. The probe shall be a handheld device positioned and touched to a mating data port on the farebox, requiring no plugs or physical electrical contact. The case of the data probe shall be a hardened aluminum extrusion or casting, containing the necessary hardware for communication between the probe and the farebox. The probe shall be configured with a window of infrared-transparent plastic behind which is a communications link composed of an LED and photosensor. A slot shall be provided within the extrusion to support the probe printed circuit board. A strain relief shall be provided to support the data cable.

   The data probe and cabling shall be capable of withstanding extended operations under extreme temperature and humidity variations and shall be impervious to degradation due to diesel fuel, gasoline, oil, transmission fluid, road salts, and sunlight. The data probe shall be capable of withstanding being dropped from a height of three (3) feet onto a concrete surface with no resulting loss of operation. An LED lamp shall be provided in an easy-to-see location on the probe to aid in

proper orientation and operation of the data probe. The LED shall pulse at a rate of once per second to indicate that the data computer is operational and the data probe is ready for use. Once the probe is interfaced with the farebox data port, the LED shall flicker while data is being exchanged and then glow steadily for five seconds to indicate that transmission has been completed.

2. Data probe cable: The data cable shall be custom made with three (3) twisted wire pairs, a shield, and a heavy polyurethane jacket flexible at low temperatures and resistant to salt, moisture, abrasion and fuel. Cable length shall be twenty-five (25) feet. The cable shall be supported in the center by a retractor mechanism designed to hold the cable out of the way when not in use. The retractor may be attached to a supporting pole or wall. A probe holder shall be provided to hold the data probe between uses and a lockable box shall be provided to hold the data probe when not in use.

3. Junction box: Each data probe cable shall terminate in a junction box containing one or more connectors for the data probe cable(s) and a terminal strip for a cable connecting the junction box to the central isolation box. Junction boxes may be mounted on the supporting pole or to an existing structure, as appropriate.

4. Supporting poles: Data probe supporting poles and all other equipment shall be properly grounded for lightning protection through existing electrical outlets. The data probe printed circuit board and isolation boxes shall have transient protection circuits.

5. Interconnection cable: Each data probe junction box shall be connected to a central isolation box. Both ends of the cable shall attach to screw terminals. Maximum cable length is not to exceed 1,500 feet.

6. Central isolation box: The data probe subsystem shall include an isolation box designed to protect the data computer and its operator from a near-hit by lightning. The isolation box shall contain a separate opto-isolating printed circuit board for each data probe powered from a common power supply. Terminal strips shall be provided for connection to each of the data probes. The isolation box shall typically be mounted on a wall within 10 feet of the data computer, where its case can be properly grounded. Cables shall connect the isolation box to the data computer. The isolation box shall have its own 110 VAC grounded power cord.

7. Computer equipment: Computer equipment to be provided by Owner. Coordinate CPU specifications with owner and provide final software installation, programming, and connection to CPU for a complete and operable system.

D. Utilities: 110 VAC, 20 A.

PART 3 - EXECUTION

3.1 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.

B. Inspect delivered equipment for damage from shipping and exposure to weather.

C. Compare delivered equipment with packing lists and specifications to assure receipt of all items.

3.2 INSTALLATION

A. Perform work under direct supervision of Foreman or Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect.

B. Install equipment in accordance with plans, shop drawings and manufacturer's instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level, plumb and at right angles to adjacent work.

2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.

3. Anchorage: Attach equipment securely to floor, as directed by Architect, to prevent damage resulting from inadequate fastening. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.

4. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.3 TESTING

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to start-up inspect, test, and adjust components, assemblies, and equipment installations, including connections, check operation of the equipment and components for operation and performance as specified and examine the finish for damage. Provide report in writing that the installation meets the requirements and shall include information concerning minor adjustments and minor repairs, which may be required before final acceptance by the Owner.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment

B. Prepare test and inspection reports

C. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with all specified features in the presence of the Architect using acceptance procedures provided by the manufacturer.

3.4 CLEANUP

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing or installation debris from job site.

D. Notify Architect for acceptance inspection.

3.5 TRAINING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment.

B. Direct the technical representative to provide specified hours of training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.

1. VAULT/RECEIVER, FAREBOX, MOBILE BIN
   Equipment Mark Number: 7800
   Hours Required: 1

2. DATA COLLECTION AND REPORTING SYSTEM, FAREBOX
   Equipment Mark Number: 7820
   Hours Required: 1

C. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

D. Provide a Windows compatible movie file format recording on DVD disk of the training session. The DVD training movie can be of a live session or a produced training video.

END OF SECTION 115400

SECTION 115500- VEHICLE WASH EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

The General Provisions of the Contract, including General and Special Conditions, apply to the Work in this Section.

1.2 WORK INCLUDED

A. Equipment items as listed below by Equipment Mark Number:

1. WASHER, HI-PRESSURE/HOT WATER, NG
Equipment Mark Number: 3720
Submittal requirements: PD, OM, T

2. HOSE REEL FOR 3720
Equipment Mark Number: 3721
Submittal requirements: PD, OM, T

3. PRESSURE WASHER
Equipment Mark Number: 3722
Submittal requirements: PD, OM, T

4. WASHER, VEHICLE, DRIVE-THRU, SIX BRUSH
Equipment Mark Number: 3901
Submittal requirements: PD, OM, SD, T

5. WASHER, VEHICLE, DRIVE-THRU, HYBRID
Equipment Mark Number: 3902
Submittal requirements: PD, OM, SD, T

6. WATER RECLAMATION SYSTEM
Equipment Mark Number: 3936
Submittal requirements: PD, OM, SD, T

7. WATER RECLAMATION SYSTEM
Equipment Mark Number: 3937
Submittal requirements: PD, OM, SD, T

B. Roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.

1. Coordinate and verify all electrical and utility connections with all trades prior to equipment ordering and purchase.

C. Piping, wiring, and switching between equipment and utilities.

1.3 QUALITY ASSURANCE

A. All components shall be fully tested and documented to operate as a complete system

C. Manufacturer's Representative: The manufacturer authorized representative shall be factory trained and certified personnel providing service, startup, and quality control field labor for the project from their local office

1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out and start up.

2. Training: Provide technical representative to train Owner's maintenance personnel in operation and maintenance of specified equipment.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

B. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. Refer to above submittal requirements. The following abbreviations are used to indentify submittals required:

1. PD- Product Data

2. SD- Shop drawings

3. OM- Operation and Maintenance manual

4. T- Training of owners personnel on specific equipment items

C. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical requirements, wiring diagrams, and provided accessories.

1. Provide installation drawings showing all interconnecting utilities such as piping and electrical requirements between controller and lift.

2. Restrict submitted material to pertinent data. For instance, do not include manufacturer's complete catalog when pertinent information is contained on a single page.

D. Shop drawings and schematics detailing fabrication, installation, piping layout, materials and finishes, system interconnections, and utility connections of equipment assemblies. Indicate dimensions, weights, loadings, foundations, final dimensions, required clearances, method of field assembly, components, and location and size of each field connection.

1.4 INFORMATION SUBMITTALS

A. Delegated-design submittal: Final design and coordination of the bus wash foundation, pit depth and by the wash manufacturer. For equipment supports and foundations to comply with performance requirements and design criteria, including analysis data signed and sealed by a qualified Connecticut professional engineer responsible for their preparation

B. Factory tests and inspection reports prior to shipping.

C. Field test and start-up reports, indicating and interpreting test results relative to compliance with specified requirements, for information.

D. Certificates: For certification required in "Quality Assurance" Article

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For the equipment identified to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For bus wash systems specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR- CLOSEOUT DOCUMENTS.

1.5 MAINTENANCE MATERIAL SUBMITTALS

C. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set(s) for each belt-driven unit

2. Filters: one set for each unit containing a filter

B. Provide one year supply of detergent and water treatment chemicals

1.7 WARRANTY

A. Washer, Vehicle, Drive-thru, Six Brush and Washer, Vehicle, Drive-thru, Hybrid:

1. Warranty work specified herein, for a period of five (5) years beginning upon substantial completion of the project, against defects in materials, workmanship, and performance.

2. Warranty shall include materials and labor necessary to correct defects, which shall include, but not be limited to the following:

a. Operation: Noisy, rough or substandard operation.

b. Parts: Loose, damaged, and missing parts.

c. Finish: Abnormal deterioration

3. The Water Reclamation System, Mark No. 3936 shall be guaranteed by the Manufacturer or Supplier to control odors for a period of three years after final acceptance and shall take whatever action is necessary to correct any odor causes during the guarantee period without the use of chemicals. Corrective action shall be at no additional cost to Owner

4. Steel framework including galvanizing, welds, and overall integrity shall be warranted for ten (10) years.

B. Warrant all other work specified herein for one year from substantial completion against defects in materials, function and workmanship.

C. Warranty shall include materials and labor necessary to correct defects.

D. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.

E. Any units or parts which prove defective during the warranty period will be replaced with OEM parts and transportation prepaid.

F. All parts shall be readily available locally in the United States.

1.5 COORDINATION

A. Coordinate size and location of all foundations, pit depth, pit size, bus wash location, supports, piping, electrical, and controls

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid, dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title of this specification.

C. Provide equipment and materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

1.9 LABELING

A. Nameplate: Manufacturer shall securely attach in a prominent location on each major item of equipment a non-corrosive nameplate with stamped figures showing manufacturer's name, address, model number, serial number and pertinent utility or operating data.

B. Label all piping in vehicle wash and water reclaim systems as to its function and flow direction.

C. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (U.L.), or other National Recognized Testing Laboratory (NRTL), in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant.

PART 2 – PRODUCTS

2.1 WASHER, HI-PRESSURE/HOT WATER, NG
Equipment Mark Number: 3720

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Hotsy Corporation.

B. General Description:

1. Hi-pressure/hot water natural gas fired washer shall be designed for effective cleaning of vehicle exteriors through the use of handheld wash wands. Washer shall be complete and operable with all equipment items necessary for a complete wash system, including required piping to all hose reels and wash wands shown on the Drawings.

2. OSHA requirements: The system shall meet or exceed all applicable OSHA standards.

3. Electrical wiring: Electrical wiring shall be in accordance with the latest edition of the National Electric Code and the appropriate sections of Division 26.

4. Certification: Unit must be ETL, UL, CGA or CSA certified and must conform with UL Standard 1776 for pressure washers.

C. Capacities and Dimensions:

1. Pump motor: 20 HP, 1,725 RPM.

2. Maximum discharge capacity: 7.8 GPM.

3. Operating pressure: 3,000 PSI.

4. Float tank capacity: 10 gallons.

5. Heat rise capability: 140 degrees F at 8 GPM.

6. Hose:

a. Inside diameter: 1/2 inch.

b. Length: 50 feet.

c. Burst pressure: 12,000 PSI, minimum.

d. Quantity: One each.

D. Features and Construction:

1. Fabrication: Unit shall be welded frame with enclosed motor cabinet, and enclosed coil cabinet.

2. Water pump: High-pressure pump shall have positive displacement with ceramic plungers, forged brass head, oil bath crankcase, and Buna-N and cloth "V" seals. Both sides of pump shall be fed from the float tank. Pump shall have an oil drain for ease of oil changes.

3. Burner: 720,450 BTU/hour ring type natural draft gas burner shall have aspirating spuds and AGA-listed controls. Manually operated pilot shut-off valve shall be provided to independently shut-off gas supply to pilot. Unit shall be equipped with 24 volt electronic spark ignition. Sealed pressure switch shall control opening and closing of gas valve.

4. Heating coil: Vertically fired water heating coil shall be fabricated with 300 feet of 1 inch, hydrostatic pressure tested tubing, 14,900 PSI burst pressure rated. Coil skin shall be aluminized steel for corrosion resistance. Heating coil to be insulated with fiberfrax ceramic blanket.

5. Wand assembly: Trigger gun control with 48-inch chrome plated wand and polymer insulated grip and side handle.

6. Nozzles: Three hardened stainless steel nozzles with 1/4 inch male quick coupler shall be provided, one each 0 degree, 15 degree, and 40 degree patterns.

7. Pump drive motor: Belt drive system with triple groove cast iron pulleys, grip notch V-section banded belt and auto tensioning arm for belt alignment and tension shall be provided. Motor shall be mounted to side out rails for removal. Belts and pulleys shall be covered for operator safety.

8. Float tank: Float tank shall be composed of polyethylene plastic with automatic nonplugging float valve.

9. Unloader valve: Pressure maintenance during multiple gun operation shall be provided by unloader valve.

10. Pressure switch: Automatic burner shut-off protection shall be provided by pressure switch.

11. Relief valve: Pressure relief valve shall be located at the discharge port of the coil for over pressurization protection.

12. Thermostat: Adjustable thermostat shall control water temperature to a maximum of 248 degrees F.

E. Controls: Control panel shall include magnetic motor control with overload protection and ON/OFF water heater switch, individual burner and motor rocker style monetary switches, adjustable temperature controller, hour meter and detergent metering valve, safety and pressure relief value, pressure switch.

F. Accessories:

1. Draft diverter, 12 inch, natural gas, Hotsy No. 87177300, one each.

2. Remote control (Smart Box): Remote water tight three button control system to activate unit and HEAT/SOAP and rinse function with timer and automatic shut-off, Hotsy No. 89169890, one each.

3. Security keyswitch: Remote water resistant key switch to secure operation of Hotsy equipment to authorized personnel, Hotsy (San Antonio – Smart Control Systems, LLC, DBA Hotsy Equipment Co., 3452 IH35 North, Suite 120, San Antonio, Texas 78219, 800-468-7999) No. 75.0401.

4. Structural machine stand-four feet tall. Stand to be fabricated from stainless steel angle with welded connections.

G. Utilities Available:

1. Electrical: 460 VAC, 3 phase, 20 HP.

2. Water: 3/4 inch, 8 GPM.

3. Natural gas: 720 CFH.

4. Exhaust: 10 inch with draft diverter.

H. Finish: Epoxy powder coating in manufacturer's standard color.

2.2 HOSE REEL FOR 3720
Equipment Mark Number: 3721

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Hotsy Corporation

B. General Description:

1. Hose Reel for mark Number 3720

2. OSHA requirements: The system shall meet or exceed all applicable OSHA standards.

3. Electrical wiring: Electrical wiring shall be in accordance with the latest edition of the National Electric Code and the appropriate sections of Division 26.

C. Capacities and Dimensions:

1. Hose:

a. Inside diameter: 1/2 inch.

b. Length: 50 feet.

c. Burst pressure: 12,000 PSI, minimum.

d. Quantity: One each.

D. Features and Construction:

1. Wand assembly: Trigger gun control with 48-inch chrome plated wand and insulated grip and side handle.

2. Nozzles: Three hardened stainless steel nozzles with 1/4 inch male quick coupler shall be provided, one each 0 degree, 15 degree, and 40 degree patterns.

E. Components:

1. Wand and hose assembly: One each in addition to standard wand and hose assembly. Hose (50 foot), Hotsy No. 87393930, one each. Gun, Hotsy No. 8749170, one each. Lance, Hotsy No. 87253880, one each. Quick Disconnect, Hotsy No. 98021640, two each. . Nozzle (0 degree), Hotsy No. 87087010, one each. Nozzle (15 degree), Hotsy No. 87087020, one each. Nozzle (40 degree), Hotsy No. 87087040, one each.

2. Hose Reel: Manually retractable reel capable of housing 1/2 inch 50 foot hose, Hotsy No. 89045180, one each with wall mounting kit, Hotsy No. 98022680.

F. Finish: Manufacturer's standard finish in manufacturer’s standard color.

2.3 PRESSURE WASHER
Equipment Mark Number: 3722

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Hotsy Corporation

B. Capacities and Dimensions

1. Pump motor: 6 HP, 1,725 RPM.

2. Maximum discharge capacity: 3.9 GPM.

3. Operating pressure: 2,000 PSI.

4. Hose:

a. Inside diameter: 1/2 inch.

b. Length: 50 feet.

c. Burst pressure: 12,000 PSI, minimum.

d. Quantity: One each.

C. Features and Construction

1. Electric powered, belt driven

2. Belt: Notched V-belt

3. Wand assembly: Trigger gun control with 48-inch chrome plated wand and insulated grip and side handle.

4. Nozzles: Three hardened stainless steel nozzles with 1/4 inch male quick coupler shall be provided, one each 0 degree, 15 degree, 25 degree, and 40 degree patterns.

D. Controls : ON/OFF switching and other electrical controls shall meet applicable National Electrical Code requirements

E. Accessories

1. Hose reel kit, Hotsy No, 8.903-039.0

2. Cart, Hotsy No. 9.801-034.0

3. Caster Wheel Kit, Hotsy No. 9.801-035.0

4. Stainless steel base and cover, Hotsy No. 8.903-042.0

5. Timer delay shutdown to automatically shut the machine down.

6. Provide with 10 ft power cord and plug. Coordinate plug configuration with installing contractor.

F. Utilities Available

1. Electrical: 208 VAC, 3 phase, 6 HP.

2. Water: 1/2 inch, 3.9 GPM.

G. Finish: Manufacturer's standard finish in manufacturer’s standard color

2.4 WASHER, VEHICLE, DRIVE-THRU, SIX BRUSH
Equipment Mark Number: 3901
WATER RECLAMATION SYSTEM
Equipment Mark Number: 3936

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Westmatic.

B. General Description:

1. Heavy-duty six-brush stationary drive through bus wash capable of washing a high volume of various sizes and styles of buses with or without bike racks. The

machine shall control the wash process to provide a consistent wash result without relying on the judgment of individual drivers. The need for speed sensors, and warning buzzers are not required.

2. The unit is to be manufactured according to quality assurance standards of ISO 9001 and environmental standards of ISO 14001

3. This system is to be capable of washing the front and rear of the transit buses with brushes several times on a single wash and include a special mirror protection program. The machine is to fully control the degree of brush pressure delivered to the bus and automatically adjust as required.

4. The wash functions of this system are to operate automatically and be controlled by infra-red technology. The wash system shall regulate the washing action and speed of the drivers to maximize cleaning results while minimizing incidents of damage to buses or machine.

5. The system is to be complete with all control systems, metering devices, drive motors, and brush assemblies to make a complete and operable system

6. Operation of washer shall be programmable for optimum cleaning of various sized vehicles of owner's fleet.

C. Performance:

1. The Manufacturer or Supplier of the Vehicle Washer, Mark Number 3901 shall be responsible for the design of a washer that satisfactorily washes the Owner's vehicle fleet.

a. The washer shall remove all visible, heavy dirt accumulation and most of the road film from all surfaces including the rear of the Owner's vehicles.

D. The Manufacturer or Supplier of the Vehicle Washer shall be solely responsible for the performance of the washer, as specified, and shall modify, add to, or alter the equipment, as necessary, without any additional cost to the Owner, to provide a satisfactory performance.

E. The brush unit, pumping stations and all electrical controls shall be designed, assembled and supplied by one manufacturer.

F. Minimum of 5 past successive years regularly engaged in the manufacture of bus washers

G. Submit the following information:

1. Provide name of contact person at each installation location who is familiar with the operation and maintenance of the wash system equipment.

2. Provide a sample copy of a typical Operations Manual of similar equipment package as is specified herein. The manual to be prepared according to these specifications requirements.

3. Provide other pertinent information, which details the equipment ratings, performance and applicability of the supplier's proposed vehicle wash system

H. Equipment Assembly and Testing

1. Assemble and test all equipment at the factory prior to shipment.

2. Ship equipment disassembled only to the extent deemed necessary for reasons of shipping limitations, handling facilities and avoiding damage.

3. Hydrostatically test all pressurized equipment at two (2) times working pressure.

4. Balance all pump impellers statically, dynamically, and hydraulically and test for design flow and head.

5. Test all factory wired control panels for proper operation.

6. Each motor shall have its insulation resistance to ground measured with 1000 volt "Megger" prior to connections. Make record of these values. Values of resistance of less than ten meg ohms will not be acceptable

I. Installation:

1. Install all components according to manufacturer's installation and specifications.

2. Coordinate installation of equipment with other related work as scheduled or indicated on contract drawings.

3. Vehicle Wash Equipment manufacturer is to provide all final interconnections to and between wash equipment in order to provide a complete and operable system. This includes all water piping, compressed air piping, electrical power and conduit, and control wiring and conduit. Bus wash manufacturer is responsible for all coordination with other trades including final location of bus wash equipment, foundation requirements, and utility requirements. Bus wash manufacturer to provide all motor starters, disconnect switches, and transformers required. Bus wash manufacturer is responsible for all final connections to water, electric, and compressed air utility mains terminated within the water reclaim room. Refer to drawings for further information.

J. Bus wash operation:

1. As the bus approaches the system, just before reaching the brushes, the driver is signaled to stop by a red light (traffic light). When the bus is stationary, the second set of brushes (3 & 4) move into the front of the vehicle above the bike rack. The front area is cleaned by a side-to-side crossover overlapping movement. The system shall be capable of performing multiple side to side passes with the brushes during the front wash sequence. The number of passes shall be adjustable to meet the transit agency's needs. Once the front wash is complete, the brushes which just washed the front will withdraw and move automatically around the mirrors (Automatic Mirror Protection). The first set of

brushes (1 & 2), which are full length, will activate and load into the sides of the bus. The driver will then receive a green light indicating to proceed. As the bus proceeds forward and the mirrors pass the second set of brushes, they will activate and load into the sides of the bus. Finally, the third set of brushes (5 & 6) will move in to clean the area at the front, on each side of the bike rack and will also clean the lower portion of the sides as the bus moves forward. The second and third set of brushes rotate in the opposite direction than the first set, which will reduce effects of shadowing. When the rear of the bus enters the brush station, the driver is signaled to stop by a red light (traffic light). The first set of brushes shall then move into the back of the bus, cleaning with a side-to-side crossover overlapping movement. The number of passes is programmed to the transit agency's desires. Alternate program choices are available to accommodate differing styles of buses within the fleet. Once the rear has been cleaned, driver is indicated to proceed by the traffic light. The bus then proceeds through the final rinse arch as it exits the wash. Total wash time to be 60-90 seconds

K. Capacity and Dimensions:

1. Vehicle dimensions, nominal:

a. Length

1) Maximum- 40 feet.

2) Minimum- 25 feet

b. Width: 8 feet, 6 inches (plus mirrors).

c. Height: 11 feet, 4 inches.

L. Features/Performance/Construction

1. Machine Structure:

a. All frame structures shall be hot dip galvanized with a minimum of Four (4) main structural support leg columns each made of 6" X 6" X ¼" square tubing. All frame structures shall be hot dip galvanized.

2. Brushes:

a. The system shall be equipped with 6 vertical brushes. The first set (brushes 1 & 2) shall be suspended and full length, capable of washing the vehicle's front if desired, as well as the rear of the bus multiple times with an overlapping movement. This set of brushes will also wash the vehicle's sides and shall be equipped with an automated mirror avoidance program. This function shall be capable of multiple programs to accommodate various styles of buses that exist in the fleet presently, and any future styles that may be procured during the lifetime of the wash system. These brushes rotate in opposite direction to brushes 3, 4, 5 & 6 to reduce shadowing effects. The second set and third sets of are pneumatic controlled and are to continue to wash the vehicle's sides. All pneumatic components shall be designed for lubrication free operation. Brush pressure is to be electrically controlled, with the inclusion of an amperage

meter for brushes 1 & 2 which constantly monitors pressure on the vehicle's surface. The movements of these overlapping brushes are electrically driven with electrical motors and worm gear boxes via maintenance-free, steel reinforced cog belts. These brushes must be capable of moving in / out laterally and forward / backward (parallel to the wash bay) These movements must allow automatic brush pressure adjustments forward / backward into the front and rear of the bus, as well as in / out for the sides of the bus. The parallel and lateral movements must operate independently of each other. Should pressure become too high due to malfunction or driver error, the system shall automatically shut down to prevent damage. The cause of the shutdown shall be indicated on an LCD screen within the control panel. Reactivation of the system shall be achieved by resetting the alarm/breaker switch. Brushes 5 and 6 are to have pneumatic pressure regulation. Brush pressure is to be self-monitoring and self-adjusting to pre-programmed levels automatically, prior to the commencement of each wash.

b. Bristles shall be polyethylene material that is "X" grooved to facilitate water and detergent delivery. The tips shall be flagged to provide soft touch to prevent scratching to glass and paint. Each brush section shall consist of a pliable plastic backing which is mounted to a 4-3/4" hot dip galvanized steel tubing with a wall thickness of 0.16 inch. All sections of each brush unit shall be full density with a minimum of 84 tips per square inch on all brush sections. Start and stopping of the brushes shall be achieved through infra-red photo cells.Brushes shall have a provision of water and detergent delivery. The mixture of detergent to brushes shall be adjustable from the floor level allowing for adaptation to wash conditions. Piping shall be galvanized with brass spray tips. Brushes are to be driven by High-Efficiency, energy efficient and durable 3 HP, 3 phase, 60Hz TEFC motors. Infra-red sensors shall be controlled in such a manner as to not start the machine by pedestrian traffic

3. Pre soak/ detergent arch

a. The pre-soak arch shall deliver approximately 4 gallons per minute at 45 PSI, to provide efficient and economical vehicle coverage. The spray pipes are manufactured of Stainless Steel. Spray tips shall be brass and equipped with quick disconnects. The pre-soak arch shall be designed in 3 parts, to provide complete coverage of the sides, front and rear. Each part is equipped with a brass solenoid valve to maximize effectiveness. To maximize efficiency and reduce chemical costs, spray to the front and rear of the vehicles shall only be applied when those portions of the vehicle are under the spray arch. The functions of start, stop, sprays for front, and back, shall be controlled infra-red sensors

4. Detergent Mixing System

a. 10G (40-liter) buffer tank for mixing detergent (pre-soak) with automatic mixing of concentrated detergent and water

b. Pre-determined mix of water and detergent automatically refilled through valve operated by a float Mixture can be changed for winter or summer conditions by changing the nozzle in suction hose of the detergent.

Equipment is delivered with a large number of color-coded nozzles, where each color represents a specific mixture

c. To prevent separation of detergent from water when equipment is inactive, the equipment is delivered with a bypass-type mixture device from pump to tank

d. Detergent pump is placed on a galvanized floor stand under the buffer tank

5. High Pressure Arch

a. Designed with optimized high-pressure spray pattern to clean the fronts of vehicles and augment washing on front, sides and rear of odd shaped vehicles.

b. Galvanized steel high-pressure pipe (one each side). Minimum 12 stainless steel spray nozzles.

c. Buffer tank 400G manufactured in plastic with automatic refill and level control. Includes suction and bypass connections, shut-off valves and low water level pump protection

6. Traffic Lights:

a. Bus drivers will be directed throughout the entire wash process with a minimum of two LED-traffic lights (Red/Green). Lights will interact and be a function of the control system. Traffic lights shall be contained in a watertight enclosure and are DOT approved

7. Final Rinse Arch

a. The final rinse spray arch shall consist of a 3/4 inch galvanized pipe equipped with no less than 20 brass spray tips, mounted on a galvanized frame.

b. The system shall provide a complete final rinse utilizing no more than 30 GPM @ 45 PSI

8. Water Recycling System with Ozone Generator

a. System Performance: A wash water reclamation system shall be provided to support 2 vehicle washers by reclaiming all wash and rinse water for reuse in wash cycles. Pumps, separators, controls and valves shall all be located above grade, easily serviceable, and provision shall be made to continuously polish the wash water, storing in advance of use in a wash water-receiving tank outfitted with an overflow port.

b. To achieve highest economical level of water recycling without the use of any chemical additives.

c. Recycling of approximately 85% of used water.

d. Stainless Steel hydro-cyclones as mechanical purifying unit.

e. Purification level down to particle size 10 microns density 2 with dirt load of 1 g/liter.

f. Fresh water cross-over shall be included (in case of disrupted operation).

g. Hot dipped galvanized framework

h. System includes an Ozone generator for removal of bacteria and odors in recycled water. Completely automatic function producing approximately 5 gr ozone/hour.

9. Tire Guide Rails

a. The tire guide rails shall be flared at the entrance to facilitate entrance into the wash. The guide rails shall be constructed of 4” tubular steel pipe. Rail height is not to exceed 6”. All sections shall be smoothly finished to avoid damage to tires. Rails are to be anchored to the floor with ½” galvanized or non-corrosive concrete lag bolts.

b. All components of the tire guide rails shall be stainless steel.

10. PVC Splash Guards

a. Machine delivered with brushes completely covered with side splash guard made of PVC protected polyester

b. Hot dipped galvanized frame work

11. Controls

a. The system shall be equipped with self-diagnostic software that indicates any errors, malfunctions, or other stoppages via the LCD display screen. The nature of the shutdown shall be displayed on the XBT-control panel (LCD screen). The terminal has three different color backgrounds depending on the status of the machine; Green for OPERATIONAL MODE, Orange for EMERGENCY STOP and Red for ALARM. The XBT terminal in the machine’s main electric control box adjusts the load sensitive power relays.

b. The system shall include a counter that displays the number of washes performed, both collectively and in various programs chosen. The system is to contain the capability to perform numerous unique wash programs for differing wash choices. Alternate wash selections can be activated by the driver on a control panel prior to commencing the wash. The M340 PLC-steering shall control and monitor the entire cleaning process.

c. All wash components are to be activated by infra-red eyes.

d. All electrical components shall be UL/ULC listed. All control panels shall be UL/ULC listed as a complete enclosed industrial control panel. The main control panel is to include an Ethernet module for use with customer supplied network connection that will allow for functions such as off-site adjustment to wash programs when desired.

e. Front and rear wash process can be programmed for multiple passes of the brushes. The Ethernet module will also permit off-site technical support, and diagnosis.

f. There shall be five emergency stop buttons, one located on each corner of the machine and one on the main control box.

g. The main control box shall include an XBT-control panel with a LCD-screen to provide the following standard functions:

1) Program 1: Buses with Bike Racks (Front, Sides and Rear Wash, complete wash)

2) Program 2: Buses w/o Bike Racks (Front, Sides and Rear Wash, complete wash)

3) Program 3: Sides and Rear Wash

4) Program 3: Sides only

5) Start Wash

6) Drive Through Without Wash

7) Brushes 1 & 2 Off/On

8) Brushes 3 & 4 Off/On

9) Brushes 5 & 6 Off/On

10) Detergent Arch Off/On

11) High Pressure Arch Off/On (Optional)

12) Alternate Wash Programs

13) Emergency Stop

14) Emergency Stop Reset

12. Provide with an Ethernet module to enable contact between the machine's PLC and the factory for remote diagnostics and off-site program adjustments (network/ internet access required)

13. Skid Plates

a. Provide flat, polished 3/16 inch thick stainless steel skid plates mounted flush to slab. Angled entry section of tire guide shall minimize tire sidewall damage caused by resistance to lateral movement resulting from misaligned entry to vehicle washer. Plates shall be nominally 4 feet 6 inches wide tapering with tire guide angle to 3 feet 6 inches wide at entrance to straight section of tire guides. Plates shall be 11 feet long.

14. Solenoid Valves: Fresh water solenoid valve shall be slow-closing type to prevent hammering and stress on water lines. All water solenoid valves shall be union isolated

15. Chassis wash

    a. The underbody wash station shall be supplied by a 25HP Pump, 91GPM @ 285psi. This chassis wash shall have its own, dedicated high-pressure pump.

    b. There shall be one (1) chassis wash stations in each bus washer lane, activated by individual photo cells and shall function as follows:

    c. As bus approaches first chassis wash station the underbody is washed with high pressure recycled water.

    d. All chassis wash pipes, pipe fittings, nozzles, etc. shall be recessed in concrete floor so as not to create a tripping safety hazard. Spray nozzles shall be made of stainless steel. Spray piping shall be galvanized

    e. Chassis wash spray system shall be furnished complete with all hose kits, foot valves, relief valves, shut off valves, suction and bypass connections, low water pump protection, actuation controls, and all other required hardware and incidental components necessary for a complete installation working separately or integrated with overall wash cycle controls.

    f. Provide stainless steel cover to cover trench associated with the chassis wash.

16. High Pressure Wheel Wash

    a. Designed with optimized high-pressure spray pattern to clean the vehicle wheels, rims and rocker panels

    b. Galvanized steel high-pressure pipe (one each side). Minimum 12 stainless steel spray nozzles.

    c. Wheel wash pipes shall suspended by floor mounted brackets on either side of the wash bay

17. Pumps

    a. Pre soak detergent arch:

        1) Stainless steel corrosion-resistant horizontal multi-stage centrifugal pump

        2) Capacity 6.6GPM (25 liters/min) at 60 psi (4.0 bar)

        3) Direct drive single-phase electric motor.

        4) Carbon-type shaft seal

5) Relief valve of washer-type and bypass function included

6) Inlet filter

b. High pressure wash pump:

1) Used to supply the tire, chassis wash, and the overhead high pressure arch.

2) The High-Pressure Pump shall be a multi-stage vertical stainless steel centrifugal type with a 25hp direct-drive, direct-start motor. Capacity 92GPM at 285psi. All vital parts are polished stainless steel SIS 2333. Pump is delivered with all connector hoses

c. Detergent Pump:

1) A diaphragm metering pump shall inject concentrated detergent into the wash water. The pump shall operate on 120 VAC power. Pump shall include double ball inlet and outlet cartridge type ceramic check valves. Chemical resistant PVDF valve body and fittings, ceramic balls, Viton seals and TFP/P ball seat o-rings. No metal springs are used. Pump shall be capable of a maximum output of 5.9 OZ/Min @ 125 PSI. Output shall be adjustable from 5-100% via stroke length adjustment

d. Water recycling system and ozone generator

1) All pumps are designed for dirty water with oil resistant gaskets and ceramic seals.

2) Submersible pump, 3/4HP, for recycled water, is mounted in ground tank / pit

3) Multi-stage vertical stainless steel centrifugal type filter pump with a 5hp direct drive motor. Capacity 72GPM (275 liters/min) at 71psi (5.0 bar). All vital parts are polished stainless steel SIS 2333. Pump is delivered with all connectors

4) Brush Recycled Water Feed Pump: Multi-stage vertical stainless steel centrifugal type with a 3hp direct drive motor. Capacity 44GPM (165 liters/min) at 71psi (5.0 bar). All vital parts are polished stainless steel SIS 2333. Pump is delivered with all connectors

M. Finish: Metallic surfaces not suitable for galvanizing shall be coated with 95% zinc primer and covered with durable machine enamel. All erection bolts shall be plated Grade 5.

N. Utilities Required:

1. Electrical:

a. 480V/3 phase, 30 amp- main control panel for the brush wash

b. 480V/3 phase, 80 amp- pump control panel

c. 120 V/1 phase, 15 amp- Ozone generator

2. Air: 1/2 inch supply line at 60 PSIG, 14 cfm

3. Water: 1 ½ inch supply line at 60 PSIG, minimum.

4. Drain: 4 inch, minimum overflow to sewer from reclaim pit.

2.5 WASHER, VEHICLE, DRIVE-THRU, HYBRID
Equipment Mark Number: 3902
WATER RECLAMATION SYSTEM
Equipment Mark Number: 3937

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Westmatic.

B. General Description:

1. Heavy-duty two-brush stationary hybrid drive through vehicle wash capable of washing a high volume of various sizes and styles of vehicles. The machine shall control the wash process to provide a consistent wash result without relying on the judgment of individual drivers. The need for speed sensors, and warning buzzers are not required

2. The unit is to be manufactured according to quality assurance standards of ISO 9001 and environmental standards of ISO 14001

3. This system is capable of washing the front and rear of the vehicles several times during a single pass and includes a special mirror protection program. The front of the vehicle shall be washed with robotic high pressure booms or brushes. The machine fully controls the degree of brush pressure delivered to the vehicle and automatically adjusts as required. For optimal wash result, the vehicle MUST stop to wash the front and rear.

4. The wash functions of this system are operated automatically and controlled by infra-red technology. The wash system shall regulate the washings actions and speed of the drivers to maximize cleaning results while minimizing incidents of damage to vehicles or machine.

5. The system is complete with all control systems, metering devices, drive motors, pump stations and brush assemblies

C. Performance:

1. The Manufacturer or Supplier of the Vehicle Washer, Mark Number 3902 shall be responsible for the design of a washer that satisfactorily washes the Owner's vehicle fleet.

a. The washer shall remove all visible, heavy dirt accumulation and most of the road film from all surfaces including the rear of the Owner's vehicles.

D. The Manufacturer or Supplier of the Vehicle Washer shall be solely responsible for the performance of the washer, as specified, and shall modify, add to, or alter the equipment, as necessary, without any additional cost to the Owner, to provide a satisfactory performance.

E. The brush unit, pumping stations and all electrical controls shall be designed, assembled and supplied by one manufacturer.

F. Minimum of 5 past successive years regularly engaged in the manufacture of bus washers

G. Submit the following information:

1. Provide name of contact person at each installation location who is familiar with the operation and maintenance of the wash system equipment.

2. Provide a sample copy of a typical Operations Manual of similar equipment package as is specified herein. The manual to be prepared according to these specifications requirements.

3. Provide other pertinent information, which details the equipment ratings, performance and applicability of the supplier’s proposed vehicle wash system

H. Equipment Assembly and Testing

1. Assemble and test all equipment at the factory prior to shipment.

2. Ship equipment disassembled only to the extent deemed necessary for reasons of shipping limitations, handling facilities and avoiding damage.

3. Hydrostatically test all pressurized equipment at two (2) times working pressure.

4. Balance all pump impellers statically, dynamically, and hydraulically and test for design flow and head.

5. Test all factory wired control panels for proper operation.

6. Each motor shall have its insulation resistance to ground measured with 1000 volt “Megger” prior to connections. Make record of these values. Values of resistance of less than ten meg ohms will not be acceptable

I. Installation:

1. Install all components according to manufacturer’s installation and specifications.

2. Coordinate installation of equipment with other related work as scheduled or indicated on contract drawings.

3. Vehicle Wash Equipment manufacturer is to provide all final interconnections to and between wash equipment in order to provide a complete and operable system. This includes all water piping, compressed air piping, electrical power

and conduit, and control wiring and conduit. Bus wash manufacturer is responsible for all coordination with other trades including final location of bus wash equipment, foundation requirements, and utility requirements. Bus wash manufacturer to provide all motor starters, disconnect switches, and transformers required. Bus wash manufacturer is responsible for all final connections to water, electric, and compressed air utility mains terminated within the water reclaim room. Refer to drawings for further information.

J. Bus wash operation:

1. Vehicles entering the wash area will first pass under the stationary pre-rinse/detergent arch. This detergent arch is designed in 3 parts, to provide chemical coverage to the front, sides, and rear of the vehicle.

2. Just before reaching the machine, the driver is signaled to stop by a red light (traffic light). When stationary, the high pressure booms or brushes (depending on program selected) move into the center of the vehicle and the front wash begins. The front windshield area is cleaned by a side-to-side and overlapping motion. The number of passes during this segment shall be able to be programmed to the desired activity by the transit agency.

3. Once the front cleaning function is complete, the brushes/high pressure booms will withdraw and move automatically around the mirrors "Mirror Protection Program". The driver will receive a green light indicating to proceed as the side brushes move into the sides. The booms also move to an optimal washing distance. The sides of the vehicle are cleaned with brushes and high pressure water (depending on wash program selected). The high pressure pipes shall oscillate at an optimal speed during the side wash.

4. When the rear of the vehicle enters the main wash unit, the driver is signaled to stop by a red light (traffic light). The brushes or high pressure booms shall then move into the back of the vehicle, cleaning with a side-to-side and overlapping motion. The number of passes is programmed to the owner’s desires. Alternate program choices are available to accommodate differing styles of vehicles within the fleet.

5. Once the rear has been cleaned, driver is indicated to proceed by the traffic light. The vehicle then proceeds through the final rinse arch as it exits the wash.

6. Total wash time will be approximately 90 seconds.

7. The driver shall under no circumstances drive into the brushes or booms with the vehicle

K. Capacity and Dimensions:

1. Vehicle dimensions, nominal:

a. Length

1) Maximum- 40 feet.

2) Minimum- 25 feet

b. Width: 8 feet, 6 inches (plus mirrors).

c. Height: 11 feet, 4 inches.

L. Features/Performance/Construction

1. Brush Machine Housing:

a. All frame structures shall be hot dip galvanized with the main structural legs not less than 6 by 6 inches square tubing. All frame structures shall be hot dip galvanized.

2. Brushes:

a. The system shall be equipped with 2 vertical brushes. They shall be suspended and full length, capable of washing the vehicle's front if desired, as well as, the rear of the vehicle multiple times with an overlapping movement. This set of brushes will also wash the vehicle's sides and shall be equipped with an automated mirror avoidance program. This function shall be capable of multiple programs to accommodate various styles of vehicles that exist in the fleet presently, and any future styles that may be procured during the lifetime of the wash system

b. Brush pressure is to be electrically driven, with the inclusion of an amperage meter for brushes 1 to 2 which is to constantly monitor pressure on the vehicle's surface. The movements of these brushes are electrically controlled via worm gear boxes and maintenance free belts. Should pressure become too high due to malfunction or driver error, the system shall automatically shut down to prevent damage. The cause of the shut down shall be indicated on an LED screen within the main control panel. Reactivation of the system shall be achieved by resetting the breaker switch.

c. Start and stopping of the brushes shall be achieved through via infra-red photo cells.

d. Brushes shall have a provision of water and detergent delivery. The mixture of detergent to brushes shall be adjustable from the floor level allowing for adaptation to wash conditions. Piping shall be galvanized with brass spray tips. Brushes are to be driven by energy efficient and durable 3 phase TEFC motors. Infra-red sensors shall be controlled in such a manner as to not start the machine by pedestrian traffic.

e. Bristles shall be polyethylene material that is "X" grooved to facilitate water and detergent delivery. The tips shall be flagged to provide soft touch to prevent scratching to glass and paint. Each brush section shall consist of a pliable plastic backing which is mounted to a 4-3/4" hot dip galvanized steel tubing with a wall thickness of 0.16 inch. All sections of each brush unit shall be full density with a minimum of 84 tips per square inch on all brush sections.

3. Self-adjusting robotic high pressure booms

a. The system shall be equipped with 2 vertical self-adjusting robotic high pressure booms. Booms shall be suspended and full length, capable of washing the vehicle's front if desired, sides and rear of the vehicle multiple times. Booms must be capable of adapting and contouring to various sizes and shapes of different vehicles.

b. The movements of these high pressure booms (in/out) are electrically controlled via worm gear boxes and maintenance free belts.

c. Pivoting and oscillation of the vertical spray pipes shall be achieved via electric gear/motors. The pipes shall be capable of 180 degrees of rotation. The rotation mechanism shall be capable of stopping rotation at 0, 45, 90, 135, and 180 degrees when needed in order provide the best possible spray angle for the current wash process. Start and stopping of the high pressure booms shall be achieved via infra-red photo cells.

4. Pre soak/ detergent arch

a. The pre-soak arch shall deliver approximately 4 gallons per minute at 45 PSI, to provide efficient and economical vehicle coverage. The spray pipes are manufactured of Stainless Steel. Spray tips shall be brass and equipped with quick disconnects. The pre-soak arch shall be designed in 3 parts, to provide complete coverage of the sides, front and rear. Each part is equipped with a brass solenoid valve to maximize effectiveness. To maximize efficiency and reduce chemical costs, spray to the front and rear of the vehicles shall only be applied when those portions of the vehicle are under the spray arch. The functions of start, stop, sprays for front, and back, shall be controlled infra-red sensors.

5. Detergent Mixing System

a. 10G (40-liter) buffer tank for mixing detergent (pre-soak) with automatic mixing of concentrated detergent and water

b. Pre-determined mix of water and detergent automatically refilled through valve operated by a float Mixture can be changed for winter or summer conditions by changing the nozzle in suction hose of the detergent. Equipment is delivered with a large number of color-coded nozzles, where each color represents a specific mixture

c. To prevent separation of detergent from water when equipment is inactive, the equipment is delivered with a bypass-type mixture device from pump to tank

d. Detergent pump is placed on a galvanized floor stand under the buffer tank

6. Buffer Tank, for high pressure pump (qty 2)

a. Buffer tank with volume of 400G for high pressure pumps for feeding to high pressure booms and optional chassis wash. Tank made of plastic material with automatic refill via solenoid valve and level control delivered complete with suction and bypass connections and shut-off valves. Includes protection for connected pumps "running dry"

7. Traffic Lights/Speed Control System

   a. The drivers will be directed throughout the entire wash process with a minimum of two LED-traffic lights (Red/Yellow/Green). 8” diameter light modules. Lights will interact and be a function of the control system. Traffic lights will be contained in a watertight enclosure.

8. Final Rinse Arch

   a. The final rinse spray arch shall consist of a 3/4 inch galvanized pipe equipped with no less than 20 brass spray tips, mounted on a galvanized frame.

   b. The system shall provide a complete final rinse utilizing no more than 30 GPM @ 45 PSI

   c. All start/stop functions are to be activated by infrared sensors.

9. Water Recycling System with Ozone Generator

   a. System Performance: A wash water reclamation system shall be provided to support 2 vehicle washers by reclaiming all wash and rinse water for reuse in wash cycles. Pumps, separators, controls and valves shall all be located above grade, easily serviceable, and provision shall be made to continuously polish the wash water, storing in advance of use in a wash water-receiving tank outfitted with an overflow port.

   b. To achieve highest economical level of water recycling without the use of any chemical additives.

   c. Recycling of approximately 85% of used water.

   d. Stainless Steel hydro-cyclones as mechanical purifying unit.

   e. Purification level down to particle size 10 microns density 2 with dirt load of 1 g/liter.

   f. Fresh water cross-over shall be included (in case of disrupted operation).

   g. Hot dipped galvanized framework

   h. System includes an Ozone generator for removal of bacteria and odors in recycled water. Completely automatic function producing approximately 5 gr ozone/hour.

10. Tire Guide Rails

   a. The tire guide rails shall be flared at the entrance to facilitate entrance into the wash. The guide rails shall be constructed of 4” tubular steel pipe. Rail height is not to exceed 6”. All sections shall be smoothly finished to avoid damage to tires. Rails are to be anchored to the floor with ½” galvanized or non-corrosive concrete lag bolts.

b. All components of the tire guide rails shall be stainless steel.

11. PVC Splash Guards

a. Machine delivered with brushes completely covered with side splash guard made of PVC protected polyester

b. Hot dipped galvanized frame work

12. Controls

a. The system shall be equipped with self-diagnostic software that indicates any errors, malfunctions, or other stoppages via the LCD display screen. The nature of the shutdown shall be displayed on the XBT-control panel (LCD screen). The terminal has three different color backgrounds depending on the status of the machine; Green for OPERATIONAL MODE, Orange for EMERGENCY STOP and Red for ALARM. The XBT terminal in the machine's main electric control box adjusts the load sensitive power relays.

b. The system shall include a counter that displays the number of washes performed, both collectively and in various programs chosen. The system is to contain the capability to perform numerous unique wash programs for differing wash choices. Alternate wash selections can be activated by the driver on a control panel prior to commencing the wash. The M340 PLC-steering shall control and monitor the entire cleaning process.

c. All wash components are to be activated by infra-red eyes.

d. All electrical components shall be UL/ULC listed. All control panels shall be UL/ULC listed as a complete enclosed industrial control panel. The main control panel is to include an Ethernet module for use with customer supplied network connection that will allow for functions such as off-site adjustment to wash programs when desired.

e. Front and rear wash process can be programmed for multiple passes of the brushes. The Ethernet module will also permit off-site technical support, and diagnosis.

f. There shall be five emergency stop buttons, one located on each corner of the machine and one on the main control box.

g. The main control box shall include an XBT-control panel with a LCD-screen to provide the following standard functions:

1) There shall be touch-less only, brush only or combination versions of the following:

a) Buses with Bike Racks (Front, Sides and Rear Wash, complete wash)

b) Buses w/o Bike Racks (Front, Sides and Rear Wash, complete wash)

c) Sides and Rear Wash

d) Sides only

e) Touch-less only

f) Small Vehicle (Car, SUV, Pickup)-Touch-less Only

g) Drive Through Without Wash

h) Brushes 1 & 2 Off/On

i) High Pressure Booms Off/On

j) Detergent Arch Off/On

k) Emergency Stop

l) Emergency Stop Reset

13. Provide with an Ethernet module to enable contact between the machine's PLC and the factory for remote diagnostics and off-site program adjustments (network/ internet access required)

14. Skid Plates

    a. Provide oversized, flat, polished 3/16 inch thick stainless steel skid plates mounted flush to slab. Angled entry section of tire guide shall minimize tire sidewall damage caused by resistance to lateral movement resulting from misaligned entry to vehicle washer. Plates shall be nominally 4 feet 6 inches wide tapering with tire guide angle to 3 feet 6 inches wide at entrance to straight section of tire guides. Plates shall be 11 feet long.

15. Solenoid Valves: Fresh water solenoid valve shall be slow-closing type to prevent hammering and stress on water lines. All water solenoid valves shall be union isolated

16. Chassis wash

    a. There shall be one (1) chassis wash stations in each bus washer lane, activated by individual photo cells and shall function as follows:

    b. As bus approaches first chassis wash station the underbody is washed with high pressure recycled water.

    c. All chassis wash pipes, pipe fittings, nozzles, etc. shall be recessed in concrete floor so as not to create a tripping safety hazard. Spray nozzles shall be made of stainless steel. Spray piping shall be galvanized

d. Chassis wash spray system shall be furnished complete with all hose kits, foot valves, relief valves, shut off valves, suction and bypass connections, low water pump protection, actuation controls, and all other required hardware and incidental components necessary for a complete installation working separately or integrated with overall wash cycle controls.

e. Provide stainless steel cover to cover trench associated with the chassis wash.

17. High Pressure Wheel Wash

a. Designed with optimized high-pressure spray pattern to clean the vehicle wheels, rims and rocker panels

b. Galvanized steel high-pressure pipe (one each side). Minimum 12 stainless steel spray nozzles.

c. Wheel wash pipes shall suspended by floor mounted brackets on either side of the wash bay

18. Pumps

a. Pre soak detergent arch:

1) Stainless steel corrosion-resistant horizontal multi-stage centrifugal pump

2) Capacity 6.6GPM (25 liters/min) at 60 psi (4.0 bar)

3) Direct drive single-phase electric motor.

4) Carbon-type shaft seal

5) Relief valve of washer-type and bypass function included

6) Inlet filter

b. High Pressure Pump

1) Capacity Minimum 50HP Total, 60GPM @ 1200psi

2) Direct drive electric motor for the pump

3) For attaching to floor

4) Direct start

5) Connector hoses included - All vital parts in polished 304 stainless steel

c. High pressure chassis wash pump:

1) Used to supply the tire, chassis wash, and the overhead high pressure arch.

2) This chassis wash shall have its own, dedicated high-pressure pump

3) The High-Pressure Pump shall be a multi-stage vertical stainless steel centrifugal type with a 25hp direct-drive, direct-start motor. Capacity 92GPM at 285psi. All vital parts are polished stainless steel SIS 2333. Pump is delivered with all connector hoses

d. Detergent Pump:

1) A diaphragm metering pump shall inject concentrated detergent into the wash water. The pump shall operate on 120 VAC power. Pump shall include double ball inlet and outlet cartridge type ceramic check valves. Chemical resistant PVDF valve body and fittings, ceramic balls, Viton seals and TFP/P ball seat o-rings. No metal springs are used. Pump shall be capable of a maximum output of 5.9 OZ/Min @ 125 PSI. Output shall be adjustable from 5-100% via stroke length adjustment

e. Water recycling system and ozone generator

1) All pumps are designed for dirty water with oil resistant gaskets and ceramic seals.

2) Submersible pump, 3/4HP, for recycled water, is mounted in ground tank / pit

3) Multi-stage vertical stainless steel centrifugal type filter pump with a 5hp direct drive motor. Capacity 72GPM (275 liters/min) at 71psi (5.0 bar). All vital parts are polished stainless steel SIS 2333. Pump is delivered with all connectors

4) Brush Recycled Water Feed Pump: Multi-stage vertical stainless steel centrifugal type with a 3hp direct drive motor. Capacity 44GPM (165 liters/min) at 71psi (5.0 bar). All vital parts are polished stainless steel SIS 2333. Pump is delivered with all connectors

M. Finish: Metallic surfaces not suitable for galvanizing shall be coated with 95% zinc primer and covered with durable machine enamel. All erection bolts shall be plated Grade 5.

N. Utilities Required:

1. Electrical:

a. 480V/3 phase, 20 amp- main control panel for the brush wash

b. 480V/3 phase, 150 amp- pump control panel

c. 120 V/1 phase, 15 amp- Ozone generator

2. Air: 1/2 inch supply line at 60 PSIG, 14 cfm

3. Water: 1 ½ inch supply line at 60 PSIG, minimum.

4. Drain: 4 inch, minimum overflow to sewer from reclaim pit

PART 3 - EXECUTION

3.1 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.

B. Inspect delivered equipment for damage from shipping and exposure to weather. Compare delivered equipment with packing lists and specifications to assure receipt of all items.

C. Report in writing to the Architect any damaged, missing or incomplete scheduled equipment and improper rough-in work or utility stub-outs.

3.2 INSTALLATION

A. Vehicle Wash Equipment manufacturer responsible for final interconnections to wash equipment in order to provide a complete and operable system.

B. Perform work under direct supervision of Foreman or Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect.

C. Install equipment in accordance with plans, shop drawings and manufacturer's instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb and at right angles to adjacent work.

2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.

3. Anchorage: Use fastenings as specified herein. Attach equipment securely to prevent damage resulting from inadequate fastenings. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.

4. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.3 TESTING

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to start-up inspect, test, and adjust components, assemblies, and equipment installations, including connections, check operation of the equipment and components for operation and performance as specified and examine the finish for damage. Provide report in writing that the installation meets the requirements and

shall include information concerning minor adjustments and minor repairs, which may be required before final acceptance by the Owner.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment

B. Prepare test and inspection reports

C. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with all specified features in the presence of the Architect using acceptance procedures provided by the manufacturer.

D. Performance Testing: Each washer shall consecutively wash five vehicles of Owner's choosing within 45 minutes.

E. Equipment shall not damage vehicles, including mirrors, windshield wipers and windows, or equipment itself.

F. Malfunctions during testing shall be corrected within five days and re-tested. Malfunctions during second testing shall be corrected within five days and retested.

G. Inadequate Performance: If equipment fails third test, Owner may elect to have all specified Vehicle Wash Equipment removed from site at no cost or obligation to Owner.

3.4 CLEANUP

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing or installation debris from job site.

D. Notify Architect for acceptance inspection.

3.5 TRAINING

A. Direct the technical representative to provide specified hours of training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.

1. WASHER, HI-PRESSURE/HOT WATER, NG
Equipment Mark Number: 3720
Hours Required: 2

2. PRESSURE WASHER
Equipment Mark Number: 3722
Hours Required: 2

3. WASHER, VEHICLE, DRIVE-THRU, SIX BRUSH
Equipment Mark Number: 3901
Hours Required: 4

4. WASHER, VEHICLE, DRIVE-THRU, HYBRID
Equipment Mark Number: 3902
Hours Required: 4

5. WATER RECLAMATION SYSTEM, 225 GPM
Equipment Mark Number: 3936
Hours Required: 4

6. WATER RECLAMATION SYSTEM, 225 GPM
Equipment Mark Number: 3937
Hours Required: 4

B. Washer, Vehicle, Drive-thru, Six Brush and hybrid training:

1. At least 30 days prior to schedule delivery of equipment, submit to the Engineer a detailed outline of the Contractor's training program for the Customer's personnel. Include such information as the duration of the program, material and literature to be utilized, topics to be covered, and any material and equipment required to be provided by the Customer.

2. The training program shall include familiarization with equipment operation and performance and detailed instruction in operation, maintenance and test procedures and shall be provided for:

a. Engineer and Management

b. Operating Personnel

c. Maintenance Personnel.

3. The training program shall include the equipment operation and maintenance manual as a basic text for instruction. The program shall be organized to permit the Customer to develop, within its own organization, the capability to continue the education of its personnel in the proper operation, maintenance, and repair of the equipment. The Contractor shall assume no prior knowledge, on the part of the Owner's personnel, of the equipment

C. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

D. Provide a Windows compatible movie file format recording on DVD disk of the training session. The DVD training movie can be of a live session or a produced training video.

END OF SECTION 115500

SECTION 115600 – FUELING SYSTEM EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Aboveground fuel storage tanks, piping, pumps, dispensers, chipkey reader hardware, accessories, and any other component parts reasonably incidental to providing a complete fuel dispensing system.
2. Excavation, trenching, backfilling and compaction for fuel piping.

1.3 QUALITY ASSURANCE

A. American Society for Testing and Materials (ASTM)

1. A53-81a Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
2. A120-81 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses.

B. Underwriters Laboratories, Inc. (UL)

1. Requirements applicable to product listing and labeling.

C. All work shall be installed in compliance with NFPA Standards 17, 30, 30A, and 31.

D. Comply with Connecticut Department of Transportation and local state codes.

E. Comply with EPA Regulations 40 CFR Part 280.

F. This contractor, including the installation foreman shall have not less than five years continuous experience in the installation of fuel storage systems. They shall be fully qualified for fuel tank installations by the tank manufacturer and shall have attended the manufacturer's training seminar within the past two years.

G. Equipment shall be produced by a manufacturer of established reputation with a minimum of five years experience supplying specified equipment.

H. All components shall be factory tested and documented to operate as a complete system.

I. The manufacturer authorized representative shall be factory trained and certified personnel providing service, startup, and quality control field labor for the project from their local office.

J. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. Product data including rated capacities of selected model, weights (shipping, installed, and operating), furnished specialties, electrical requirements, equipment interconnections, and accessories; and installation and startup instructions.

C. Shop drawings and schematics detailing fabrication, installation, piping layout, materials and finishes, system interconnections, and utility connections of equipment assemblies. Indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

D. Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed wiring and field-installed wiring.

1.5 INFORMATION SUBMITTALS

A. Factory tests and inspection reports prior to shipping.

B. Field test and start-up reports, indicating and interpreting test results relative to compliance with specified requirements, for information.

C. Certificates: For certification required in "Quality Assurance" Article

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For the equipment identified to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS

B. Warranty: For bus wash systems specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR- CLOSEOUT DOCUMENTS

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: Provide one additional diesel fuel filter for each pump.

1.8 WARRANTY

A. Aboveground fuel storage tank
   1. Shall be warranted for 30 years against failure due to internal or external corrosion and structural failure

B. Warrant work specified herein for two years from substantial completion against defects in materials, function and workmanship.

C. Warranty shall include materials and labor necessary to correct defects.

D. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.

E. All parts shall be readily available locally in the United States.

F. Any units or parts which prove defective during the warranty period will be replaced with OEM parts and transportation prepaid.

1.9 COORDINATION

A. Coordinate size and location of all foundations, supports, piping, electrical connections, and controls.

1.10 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid or dusty conditions.

B. Label all containers, including those contained in others, on outside with item description(s) per title and Mark Number of this specification.

C. Provide equipment and materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

1.11 LABELING

A. Nameplate: Manufacturer shall securely attach in a prominent location on each major item of equipment a non-corrosive nameplate with stamped figures showing manufacturer's name, address, model number, serial number and pertinent utility or operating data.

B. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (U.L.), or other National Recognized Testing Laboratory (NRTL), in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant.

C. Provide FM Global approval labeling for all items that have been tested and labeled as such.

PART 2 - PRODUCTS

2.1 ABOVEGROUND FUEL STORAGE TANKS

A. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Modern Welding.

B. Comply with the following standards:
   1. UL 142- Underwriters Laboratories, Inc., Steel Aboveground Tanks for Flammable and Combustible Liquids.
   2. U.L. 2085, Underwriters Laboratories 2 Hour Fire Rating's Standard for Insulated.
   3. NFPA 30, National Fire Protection Association Flammable and Combustible Code.
   4. NFPA 30A, National Fire Protection Association Automotive and Marine Service Station
   5. Uniform Fire Code International Fire Code Institute
   6. B.O.C.A. National Fire Prevention Code

C. Double wall steel UL 142 and 2085 insulated fuel tank with 110% secondary containment, manholes, support saddles, required tank openings, lifting lugs and accessories.

D. Minimum annular space insulation thickness material to be 3". Only UL-2085 listed insulation material shall be used.

E. Internal Load: Tank shall be able to withstand an air pressure test of 3 to 5 psi.

F. Tank shall be designed to support accessory equipment such as ladders, pumps, floating suction, etc. when installed according to manufacturer's instructions and limitations.

G. Tank shall be provided with suitably designed and located lifting lugs which have a 2:1 safety factor

H. Tank shall be capable of storing liquids with a specific gravity up to 1.0

I. Tank is designed for operation at atmospheric pressure only. Both inner and outer tanks shall have openings of sufficient size to meet normal and emergency venting requirements stated in U.L. 142, UFC and NFPA

J. Tank shall be capable of storing gasoline, gasohol, jet fuel, avgas, diesel fuel, methanol or fuel oil at ambient temperatures.

K. Certification Plate: Underwriters Laboratories label "Insulated Secondary Containment Aboveground Tank for Flammable Liquids." shall be affixed to each tank.

L. All threaded fittings shall be of a material of construction consistent with the requirements of the Underwriters Laboratories. All fittings shall be protected using threaded plugs or suitable closure caps

M. Manways shall conform to Underwriters Laboratories 142 standard with regard to construction, bolting and gaskets.

N. Provide required support saddles: design of the steel supports shall be per approved UL listing and be able to support the weight of the tank filled to capacity.

O. Provide access ladder and platform.

P. Cylindrical construction, the primary and secondary tanks shall successfully complete an air pressure test prior to installation. While maintaining pressure of 3-5 psig on the primary tank, the annular space bounded by the primary and secondary containment tank shall be pressurized to 1 1/2 to 3 psig. The secondary tank shall then be checked for tightness.

Q. The interstitial space between the primary tank and the secondary tank shall be suitable for monitoring leaks.

R. Tank to be retested at the jobsite by the installer prior to installation.

S. Provide required coupling kits for pipe penetrations through enclosure.

T. Provide electrical fitting kits for 3/4 in. and 1 in. electrical conduit penetrations through enclosures.

2.2 PIPING

A. Below ground fuel piping: Flexible double wall PVDF construction with primary inner barrier, structural body, primary pipe outer barrier, and secondary pipe.
   1. The outer containment pipe shall include stand-off ribs to create a small interstitial space which allows for optimum fluid migration, continuous monitoring, and easy testing.
   2. Comply with UL971. Primary and secondary piping to be UL listed.
   3. No unions, fittings, or joints, are to be used in underground piping. Piping to be continuous. If a joint is required, joint to made within a fiberglass piping sump. Transition from schedule 40 pipe to fiberglass within fiberglass piping sumps.
   4. Kynar lined

B. Above ground piping: Seamless steel schedule 40 pipe and fittings rated at 150 psi with factory applied corrosion resistive coating.
   1. Provide butt welded joints with welded fittings except at valves and specialties requiring threaded joints.

C. All piping shall be compatible with the product being distributed.

D. Piping trenches will not exceed 2.5 feet in width and will be deep to provide a minimum cover of 18 inches over pipe to finished grade.

E. Provide underground detectable warning tape above piping within trench.

F. Bottom of trenches must be thoroughly compacted with 6 inches of clean, washed pea gravel (1/8 inch to 3/4 inch particles) or crushed rock (1/8 inch to 1/2 inch particles) must be provided under, on top and on sides of pipe. Backfill to subgrade may be same material or thoroughly select fill.

G. Sand, gravel or rock under pipe must be compacted and graded to provide a minimum slope of 1/16 inch per foot to a fiberglass sump that is connected to a tank monitoring system. Slope of pipe is to be verified with the use of a spirit level to the satisfaction of the Project Engineer.

2.3 ISLAND MOUNTED FUEL DISPENSER

A. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Dresser Wayne

B. UL listed and labeled.

C. Compatibility: For dispensing low viscosity petroleum fuels- diesel; biodiesel blends up to 20 % gasoline; gasoline including oxygenated blends, and kerosene.

D. LCD Displays: Backlit 1” six-digit volume display and ½” four character status display per hose. Displays on each corresponding nozzle boot side. Configurable 0-4 digits to right decimal. Programmable gallons. In event of power loss, displays remain visible for approximately 15 minutes.

E. Totalizer: 7-digit electromechanical non-resettable totalizer per hose.

F. Meter: Reliable, micro-accurate 2-possition positive displacement with integral intelligent pulsar. Compact design with two meters in one housing. Electronic calibrations.

G. Dispenser Flow: 10 GPM each hose.

H. Electrical: 120 V

I. Flow control: Proportional 7/8” valve.

J. Cabinet Finish: Powder-coated metallic silver sides, top, and base. Doors painted as selected by owner. Black register face with black decal with white lettering.

K. Cabinet Construction: Stainless steel lower cabinet with stainless steel doors. Hinged door for convenient service access.

L. Lighted Product ID Panels: Light for displays also illuminates product ID panel.

M. Nozzle Boot: Fits UL interchangeable nozzles. Lift nozzle hook for activation.

N. Pulse output interface: Emulated mechanical dispenser interface for connection to fuel management and tank monitoring system.

2.4 PEDESTAL DIESEL DISPENSERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by PMC.

B. UL listed and labeled

C. Compatibility: For dispensing low viscosity petroleum fuels- diesel; biodiesel blends up to 20 % gasoline; gasoline including oxygenated blends, and kerosene

D. Pedestal with 8-1/2” steel column made from 12 gauge steel and 14” square base made from 7 gauge steel.
   1. Finish: Powder coated OSHA safety green

E. Meter: Rotary, positive displacement, high accuracy with normal operating range of 5 to 60 GPM.

F. Register: 5 digit resettable counter and a 7 digit non-resettable totalizer reading in 10th gaollons.

G. Provide the following manufacturer optional accessories:
   1. Veeder-Root 100:1 pulser on register
   2. Veeder-Root interlock switch kit for register
   3. Fuel block on the discharge side of the meter to supply a satellite hose stand
   4. Large numeral counter
   5. Strainer: spin-on filter
   6. Air eliminator
   7. Elbows
   8. Normally closed solenoid valve
   9. Provide internal 20 amp DPDT on/off switch to automatically control the solenoid valve open when the nozzle boot lever is lifted. The signal is to be used to control an external solenoid valve and activate the tank pump. System to be deactivated when nozzle boot lever is lowered.

H. Electrical
   1. 120 VAC, 1 phase, 60 Hz

I. Maximum working pressure : 50 psi

J. Satellite hose stand to be provided with the same components specified above with the exception of the register and meter, provided by the same manufacturer.

2.5 FUELING COMPONENTS

A. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by OPW

B. All components are to be compatible with gasoline and diesel and are to be UL listed.

A. Transition Sump: Provides watertight transition from belowground piping to above ground piping.
   1. UL certified
   2. Red fiberglass, injection-molded FRP containment chambers.
   3. Removable top to allow access during installation of fittings and equipment.
   4. Provide flush mounted H-20 rated steel diamond plate cover with interior gasket to provide a water tight seal. Cover to be split into two separate covers. One to be removable to allow access to sump and the other includes penetrations to accommodate above ground pipe installation.
   5. Provide with concrete anchoring flanges.

6. Interior water drainage channel and drain lines.
7. Provide factory installed pre greased compression gaskets and fittings to seal water tight around steel above ground pipe

B. Submersible Pumps: Fixed-speed, 3450 rpm, two-stage centrifugal type pump motor with integral, automatic, thermal overload protection, compatible with pumped liquid. Pumps to incorporate a starting and running capacitor, with internal bleed resistor. Manufactured by ISO 9001 certified manufacturer.
1. Check valve: 2-3/4" diameter fluorocarbon viton seal constructed on cast aluminum body and steel backing washer.
2. Pressure relief valve: integral to check valve.
3. Syphon: Venturi-type siphon primer.
4. Air eliminator: Tank return path with one-way check valve to provide active air elimination.
5. Electrical disconnect: electrical yoke for positive contractor disconnect during service.
6. Control box:
   a. Double hook isolation box:
      1) Optically isolates inputs from up to eight dispensers to prevent damage to dispenser relay boards.
      2) Designed to prevent electrical feedback between dispenser hook circuits as required by NEC 514-6,1999.
      3) Fuse-protected output to submersible pump controller
      4) Electrical- 120/1 V input
      5) 300 volt surge protection
      6) Maximum ambient temperature rating: 120 deg F
      7) LED's to indicate when source power is applied and dispenser hook signals are present.
      8) Control box to latch line power to the submersible pump when the relay is energized by the dispenser signal. Control box to have switch and lockout with pilot light.
   b. Smart Controller:
      1) Relay amperage rating: 30 Amps
      2) Relay/hook signal voltage: 120/208 V
      3) Compatible with all single phase submersible
      4) Fault readout- When on, it will display the last 5 faults the controller encountered. When the switch is off only the current fault is displayed.
      5) Provide with bypass
      6) Provide with auto reset mode
      7) Accept 120 V signal from double hook isolation box.
7. Electrical
   a. 208V, 1 pH, 60 Hz

C. Full-port two-way ball valves: Brass body with stainless steel ball, Teflon seal, and manual open-close arm and a quick quarter turn handle. Compatible with gasoline and diesel fuel.

D. Emergency shut-off valves: Designed to shut-off product flow in the event of a fire. A fusible link attached to a spring-operated lever holds the poppet normally open. In the event of a fire, the fusible link melts at 165 deg F, allowing the spring-actuated poppet to shut off the flow of product.

1. Body and cap: 178S ductile iron
2. Packing nut and stem: Stainless steel
3. Disc: Viton
4. Stem seat: Viton
5. Seat ring: brass
6. Cap and packing nut seals: Viton
7. Full bore inside diameter
8. Rated at a normal pressure limit of 125 psi
9. Non-shock pressure limit of 200psi
10. Temperature limit of 200 psi

E. Dispenser sumps: Provides watertight transition from belowground piping to above ground piping.
1. UL certified
2. Solid fiberglass, Injected-molded FRP, factory sealed joint.
3. Provide factory installed concrete anchors
4. Provide with full perimeter liquid collection channel to facilitate quick leak detection and allow flexibility in locating leak sensors
5. Provide stabilizer bar kit to accommodate shear valve installation.

F. Drop tube, overfill prevention valves: Constructed of extruded aluminum, connect to the stop valve by a clevis and cotter pin assembly, allowing for submerged filling.

G. Drop tubes: .062 thick extruded aluminum, provide tube length to accommodate the desired application.

H. Bolted flexible entry boots: Install for safe seals of pipe and conduit entries in underground containment sumps. Tested to withstand a minimum of 6’ of liquid head pressure. Studded flange connection to create a positive and secure seal where the rubber contacts the sump wall and also around the pipe or conduit. Boot to provide a high compression mechanical seal and permit angled entries up to a 15-degree angle off the perpendicular center line in any direction without leaking or putting undue stress on the pipe or conduit seal.

I. Swivel bolt on couplings: double wall design, with 1/8”NPT interstitial access ports for pressure testing, eliminating the need for rubber test boots. Male NPT threaded connection.
1. Air line termination kit: 36” long tubing to provide a means of air pressure integrity testing of the pipe interstitial space after installation.

J. Swing check valves:
1. Body: cast iron
2. Seat ring: brass
3. Disc: Viton
4. Cap: Bronze
5. Full-bore inside diameter
6. Rated normal pressure limit: 125 psi
7. Temperature limit: 225 degree F
8. Cold non-shock pressure limit: 200 psi

K. Overfill prevention valves:
1. Valve body, adaptor and collar: cast aluminum
2. Poppet: cast aluminum, hard-coated
3. Cam: stainless steel

4. Follower: brass
5. Shaft: CRS zinc-plated
6. Bearing: Sintered bronze
7. Float: closed-cell nitrile
8. Nipple: 2”-3” schedule 40 steel pipe
9. Lower nipple: 2”-3” schedule 40 steal with Duragaurd coating
10. Completely automatic operation
11. Provide with tank inlet adaptor
12. Integral anti-siphon valve- introducing air/vapor into the fill line after the valve actuates, to help isolate the tank from potential siphon due to a broken or leaking remote-fill pipe.
13. Pressure rating : 150 psi

L. Emergency vents:
1. Lid: cast iron, with powder-coated finish
2. Body: aluminum
3. Shaft: zinc-plated steel
4. O-ring: buna-N
5. Weighted cast iron cover reseats once the pressure in the tank is relieved
6. Octagon shaped base

M. Nozzles:
1. Gasoline, DEF, and Diesel (standard nozzle): Pressure activated such that the nozzle will not open until pumping system is pressurized, and closes automatically when the pressure is removed.
   a. Body: aluminum
   b. Lever and lever guard: Duratuff
   c. Packing: Graphite with Teflon
   d. Disc: Viton
   e. Spout: aluminum
   f. Inlet size: 3/4”
   g. Nozzle to shut-off when falling out of vehicle and is tipped up.
   h. Provide blocker on lever guard
   i. Color as selected by owner
   j. Compatible with gasoline, DEF, and diesel
   k. UL listed
   l. Stainless steel spout
   m. Provide with hold-open clip
   n. Maximum pressure: 50 psi

2. Diesel Posi Lock:
   a. Flowrate: 20-50 GPM
   b. Material: Cast aluminum with brass and stainless steel trim
   c. Provide bumper ring and wear lugs to protect the nozzle
   d. Provide cap:
      1) Impact resistant polypropylene
      2) Flexible, thermoplastic-elastomer dust seal, resistant to diesel fuel
      3) Stainless steel retaining spring
      4) Triple stainless steel restraint assembly
   e. Level control valve that allow for a consistent 95% fill
   f. Provide a factory tested pressure relief valve to meet the requirements of the US DOT standards for fuel tank protection in a fire situation

g. Nozzle to include a built in audible whistle that stops when tank is full
h. Nozzle to automatically shut off when it senses the back pressure in the fuel tank.
i. Nozzle to be automatic shut-off twist lock.

N. Hose swivels:
1. Body: Aluminum
2. Inlet and outlet adaptor: zinc
3. Seals: Buna-N, Viton
4. Bearing: nylon
5. Two planes of rotation

O. Reconnectable breakaways:
1. Body: aluminum
2. Sleeve: HDPE
3. Seals: Viton
4. Spring: stainless steel
5. Poppet: aluminum
6. Pull force: no more than 350 pounds
7. Reconnectable after relieving line pressure
8. Breakaway poppets and sealing surfaces are protected from impact during separation by a durable plastic sleeve
9. Maximum working pressure: 50 psi

P. Hoses:
1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Parker
2. Tube: black nitrile
3. Cover: black hypalon, resistant to cuts, abrasion, sun, weather, and will not scratch or mark vehicle finish
4. Reinforcement: one wire braid
5. Temp range: -40 deg F to 180 deg F
6. Ink brand white letter color
7. Provide require couplings

Q. Hose retractors:
1. Housing: cast aluminum
2. Cable: black polyester, stretch resistant
3. Post: aluminum
4. Adjustable tension and field adjustable
5. Removable side plate for full access to the mechanism and tension adjustment
6. Kit to include box, post, bracketing, retractor, and mounting hardware

R. Emergency shut-off shear valves: If the dispenser is pulled over or dislodged by collision, the top of the valve is to break off at the integral shear groove, activating poppets and shutting off the flow of fuel.
1. Double-poppet design to shut-off supply as well as prevent release of fuel from the dispensers internal piping.
2. Top: cast iron
3. Body: cast iron
4. Disc: M-19
5. Carrier: zinc-plated steel

6. Stem: copper-nickel-chrome-plated brass
7. Poppet spring: stainless steel
8. Seal: M-19 O-ring
9. Packing nuts: brass, Teflon coated
10. Threaded inlet and outlet
11. Fusible link: a fusible link will trip the valve closed at 165 deg F to shut off fuel supply to the dispenser
12. Provide U-bolt kit for mounting to dispenser stabilizer bar
13. Integral test ports- a 3/8” test port to allow the piping system to be air-tested without breaking any piping connections
14. Thermal relief valve to relieve excessive pressure over 25 psi caused by thermal expansion of fuel in the dispenser piping system in the event of fire
15. Provide offset adaptor as required

S. Thermal pressure relief valves: stainless steel construction with a viton seal, set at the factory to 25 psi and field adjustable.

T. Atmospheric vents:
1. Body: aluminum
2. Screen: 40-mesh brass
3. Set scres: brass
4. Vent cap drain spouts extend outward to deter rainwater entry
5. 7000 scfh at 2 psi

U. Solenoid valves: Prevent accidental siphoning. Valve to power open when wither dispenser is being used and spring close when pumps are off.
1. Body: Aluminum
2. Diaphragm: Viton
3. Seals and disc: Viton
4. Springs: stainless steel
5. Rider rings: Teflon
6. Disc holder: nylon
7. Core guide: Acetal, delrin
8. Core and plugnut: stainless steel
9. Strainer: 100-mesh screen
10. Explosion proof shell and water tight
11. 120 V AC
12. Female NPT threaded ends

V. Mechanical tank gauges: designed to read liquid levels in above ground tank without the need for any on-site manual gauging.
1. Enclosure: powder-coated aluminum
2. Swivel base- hard-coated aluminum
3. Float: 304 stainless steel
4. Lenses: tempered borosilicate
5. Gears: Acetal
6. Gaskets and o-ring: Nitrile
7. All hardware: stainless steel
8. Angled face
9. Float buoyancy to be approved for gasoline and diesel
10. Numbering: black letters on white backgrounds, 1” tall

11. English units
12. Temperature rating: -40 deg F to 120 deg F.

W. Remote fill spill containers: designed to prevent spilled product from entering soil during filling operations
1. Horizontal fill and vapor return connections
   a. Fill adaptor: Internal spring loaded valve to automatically close to help prevent fuel spillage, Viton seal, aluminum, and stainless steel spring.
   b. Vapor recovery adaptor: Clear anodized aluminum, Nitrile gasket, stainless steel spring, and acetal resin guide.
2. 30 gallon capacity
3. Lip of the cover to extend over the body to prevent water or snow entry
4. Construction: 12-gauge epoxy-powder coated steel
5. Welded hinge and lockable hatch
6. Lockable ball valve to provide product drainage
7. Adjustable height: each leg to be independently adjustable

2.6 LEVEL MONITORING AND LEAK DETECTION SYSTEM

A. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Veeder Root

B. Sump sensors: positive alarm indication of any liquid in underground fuel storage tank piping sumps.
1. Type: hermetically sealed magnetic reed
2. Contact rating: 15 watts
3. Housing material: PVC schedule 40 tubing
4. Temperature rating: - 0 degrees C to 60 degrees C
5. Provide with sump sensor assembly, mounting strips, watertight cord grip, and mounting hardware.

C. Tank level probes: Magnetostrictive Inventory only probe
1. Stainless steel guide tube
2. Temperature rating: -40 deg F to 140 deg F
3. Adjustable spacers
4. Length to be verified prior to ordering
5. Provide installation kit.
6. Provide float kit, to be verified prior to ordering.
7. Provide with water detection.

D. Interstitial sensors for steel tanks: detects the presence of liquid in the interstitial space of a double walled steel tank. When liquid is detected the sensor sends an alarm signal to the monitor.
1. Cable length: to be verified prior to ordering
2. Temperature rating: -20 deg C to 70 deg C
3. Provide with watertight cord grips
4. Two wires are required to connect to the monitor

E. Overfill alarms and acknowledgement: Wired to an alarm relay in the monitor, the alarm relay activates the overfill alarm horn and light when a potential overfill is detected. Limits can be set at each tank location.
   1. Alarm horn: adjustable noise level from 78 to 103 dB (at 10 feet)
   2. Alarm light: 25 watt, red polycarbonate lens, 75 per minute flashing rate
   3. Alarm acknowledgement switch: when the acknowledgement button is pressed the overfill alarm shuts off and the alarm acknowledgement light illuminated. 120 volt amber lens.
   4. Enclosure: Painted steel, NEMA 4. ½" conduit connector at the bottom
   5. Supply voltage: 120VAC

F. Monitor: Web based internet browser with Ethernet connection
   1. Up to three years of data history
   2. Inventory and delivery monitoring and reporting
   3. Support up to 32 probes
   4. Interstitial/sump monitoring
   5. Dispenser sump monitoring
   6. Groundwater monitoring
   7. Email notification and reporting
   8. Vapor well monitoring
   9. Continuous statistical leak detection software built programmed into controller.
   10. 3.0 gph, .1 gph, and .2 gph in tank leak detection
   11. 3.0 gph, .1 gph, and .2 gph in line leak detection
   12. Sensor status report
   13. Sensor status history report
   14. 7.4" full VGA LCD tough screen display
   15. High resolution, high speed printer
   16. Universal compartments support universal sensor and probe module and output interface module
   17. Built-in relay for overfill alarm
   18. Supports multiple languages
   19. Intuitive and user friendly interface
   20. Single tough screen access to most functions
   21. Customizable on-board help
   22. Custom dashboard
   23. Remote web access
   24. XML web-enabled interface
   25. Up to nine communication ports
   26. Internal auto-dial fax modem communication
   27. RS-232 and RS-485 data communication
   28. USB ports for software upgrades and data backup
   29. Electrical: 120VAC

2.7 MANHOLES

A. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by OPW
B. Skirt: galvanized steel
C. Cover: steel diamond plate
D. Ring: cast iron or fabricated steel
E. Gasket: nitrile
F. Sized to accommodate sump access

G. Easy cover removal: recessed handle
H. Highway 20 rated (H20)

2.8 GANTRY, FUEL, WITH HOSE AND NOZZLE

A. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Fleet Fueling Systems

B. General Description: The fuel gantry shall be foundation mounted and designed to suspend the fueling nozzle(s) above the fuel island and allow all fleet vehicles to be refueled with one nozzle within the specified fueling envelope.

C. Minimum Capacities and Dimensions:
   1. Fueling envelope: 20 feet, minimum.
   2. Overall dimensions:
      a. Width: 23 feet 4-1/2 inches.
      b. Depth: 40-1/2 inches.
      c. Height: 144 inches.

D. Features and Construction:

E. Construction: All vertical and horizontal structural components shall be continuously welded ASTM A500 Grade B steel tubing with all butt components filet welded and shall be designed to support all fueling components. Fuel gantry to include all supports, tracks, trolleys, piping, valves, swivels, hoses, and nozzles necessary for complete operation terminating from the diesel dispenser solenoid valve. Each fueling gantry shall be supplied with one additional complete hose and nozzle assembly capable of being connected directly to the pull-away valve.

F. Pull-away: Fuel gantry shall be designed to allow for quick and spill proof separation in the event the nozzle is left connected to the vehicle and moved. A total of 2 ounce maximum spill during separation is acceptable. Upon separation, nozzle and associated hardware must be capable of being reconnected quickly and without any special tools.

G. Nozzle: The nozzle(s) shall be connected to a fuel leader hose cut to length so that the tip of the nozzle is approximately 6 inches above the floor surface when hanging freely from the fuel gantry.

H. Utilities: 1-1/2 inch diesel fuel supply union.

I. Finish: Primed with a two part epoxy primer and painted with superior grade acrylic urethane international yellow color paint

2.9 FIRE SUPPRESSION

A. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Pyro-Chem

B. Provide delegated design submittal. Provide calculations and drawings identifying the fire suppression layout and coverage.

C. The fire extinguishing system shall be the stored pressure dry chemical pre-engineered fixed nozzle type.

D. The system shall be capable of automatic and manual activation.

E. To be tested in accordance with UL 1254.

F. Installed and maintained in accordance with NFPA 17 and 30.

G. Designed for operation in a minimum 10 mile per hour wind

H. Temperature rating: -40 deg F to 120 deg F

I. Cylinder and agent
   1. Agent to be monoammonium phosphate-based dry chemical agent
   2. Cylinders- steel, tested and marked in accordance with DOT 4BW350 and used to store extinguishing agent. Charged with dry nitrogen to 350 psig at 70 deg F.
   3. Cylinder valve- pressure sealed poppet-type valve having a brass body, stainless steel stem with rubber seat washer, fusible safety relief assembly, and pressure gauge used on all agent cylinders
   4. Cylinder bracketing- cylinders shall be mounted vertically, secured by use of a steel mounting bracket affixed to a rigid bracket capable of supporting the weight of the filled cylinder and the concussion of cylinder discharge.

J. Actuation controls
   1. Control head- The control head shall be mounted directly on the valve of a pneumatic actuating cylinder. A carbon dioxide pilot cartridge that complies with MIL-C0601G shall be used as an integral component of the control head. Control head status shall be visually indicated be a set/fired indicator.
   2. Detection- The ambient temperature of the hazard area shall be monitored by fixed temperature electrical thermal detectors. When temperature of the hazard area exceeds the rating at any detector, the detector shall close a normally open switch element within the detector, sending a signal to the control head. The signal shall energize a solenoid in the control head which exercises the control head and actuates the system.
   3. Pneumatic actuation: The system shall have a PAC-series pneumatic actuating cylinder whose valve opens upon activation of the control head. The valve shall release nitrogen from the PAC cylinder into the pneumatic pipe and tubing network. This nitrogen shall depress a piston above the valve stem in each agent cylinder, opening each agent cylinder valve and releasing the pressurized agent.
   4. Manual actuation: The system shall have a mechanical manual actuation capability requiring no electrical power. This is accomplished remotely by means of a remote mechanical pull station.
   5. Auxiliary output: The system shall shut off power to all fuel dispensing units, sound an audible alarm, and send an alarm signal to the building fire alarm system in the event of system actuation. This is accomplished by means of dry contacts micro switch installed on the control head.
   6. Supervision: A solenoid monitor shall be used to supervise the integrity of all electrical actuation circuits.

K. Distribution Nozzles

1. Nozzles: The system shall utilize discharge nozzles to distribute agent throughout the hazard area. The quantity, location, and orientation of nozzles shall be determined by manufacturer engineer and manufacturer written installation manual.
2. Nozzle covers: All nozzles shall be installed with nozzle covers to prevent foreign matter from clogging the discharge nozzle.

L. Piping and fittings

1. Pipe: All pipe shall be stainless steel pipe in accordance with NFPA 17. All pipe ends shall be thoroughly reamed after cutting, and all oil, ships, and debris shall be removed prior to nozzle installation.
2. Fittings: Standard weight malleable, stainless steel fittings shall be used.
3. Size: All system pipe and fittings will be sized by manufacturer engineer and in accordance with manufacturer written installation manual.
4. Joints: No joint sealant shall be used in the discharge piping.
5. Straps: All system discharge pipe shall be securely fastened by means of pipe hangers and/or pipe straps. UL listed pipe hangers shall be used.
6. Union: A union shall be installed in the discharge piping conveniently close to the cylinder valve to permit the disconnection for inspection and service.

M. System to be installed and tested by a certified contractor.

N. System design to be by manufacturer engineer. Provide engineering services and calculations report to engineer for approval prior to ordering

2.10 ELECTRICAL

A. Provide sealoffs in conduit as required

B. Provide emergency shutoff valve (shear valve) at each dispenser and emergency push-button shutoff greater than 20 feet and within 100 feet of dispenser. Provide sign at location of emergency push-button shutoff.

1. Emergency shut off shall disconnect power to all dispensing devices, to all remote pumps serving the dispensing devices, to all associated power, control, and signal circuits, and to all other electrical equipment in the locations surrounding the fuel dispensing devices. Resetting from an emergency shut off shall require manual intervention.

C. Make all connections to electrical equipment as required for proper operation of storage tank system, including but not limited to motor starters, pumps, dispensers, and pulser units.

D. For each tank monitoring system, furnish and install shielded cable, without splices, within control conduit from each new probe and sensor to the V-R console

PART 3 - EXECUTION

3.1 FUEL TANK INSTALLATION

A. Installation shall be in accordance with manufacturer's written instructions and as noted.

B. Contractor is responsible for initial filling of all tanks.

C. Shutoff and check valves are to be equipped with a pressure-reliving device that will relieve the pressure generated by thermal expansion back to the tank.

3.2 FUEL PIPING AND ACCESSORIES

A. Installation shall be in accordance with manufacturer's written instructions and as noted.

B. Terminate piping in tanks and access manholes as called for. Make connections to equipment with flexible pipe connectors.

C. Grade piping up from tank, 1/8 in. per ft. minimum. Arrange piping to avoid any unnecessary lifts.

D. Install vent piping a minimum of 12 ft above grade and 5 ft. above the highest projection of the canopy.

3.3 TANK CONTAINMENT SUMP

A. Install in accordance with tank manufacturer's instructions. Seal all penetrations watertight with flexible boot connectors.

B. Provide manhole in concrete slab centered over the containment sump.

3.4 TANK MONITORING SYSTEM

A. Install equipment in accordance with manufacturer's written instructions. Provide testing, system start-up, adjustment and calibration by the manufacturer's authorized representative.

B. The system shall be furnished through a single supplier.

C. Provide written confirmation from the manufacturer's authorized representative that the system has been tested and is operational.

D. Overfill alarm and acknowledgement switch shall operate in conjunction with the tank monitoring system.

3.5 PRODUCT IDENTIFICATION

A. Permanently mark all tank openings. The color shall conform to the requirements of the API.

B. Provide a permanent label at the tank fill port. The label shall contain information required by the DEC.

3.6 IDENTIFICATION

A. Install continuous plastic underground warning tape identification during backfilling of excavations for fuel storage tanks and trenches for fuel piping and electrical conduits. Locate tape 6 inches to 8 inches below finished grade, directly over piping, conduit and edges of each storage tank.

3.7 INSTALLATION CHECKLISTS AND WARRANTY CARDS

A. Provide Owner’s Representative with the tank and piping manufacturer’s installation checklist and warranty cards.

B. Fill out and sign upon completion of tank installation.

3.8 FIELD QUALITY CONTROL AND TESTING

A. Manufacturer's Field Service: Engage a factory-authorized service representative to start-up inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. General:

1. Installer must test in demonstrate the integrity of tanks, piping, and secondary containment as well as the satisfactory operation of gauging an monitoring systems, before the storage tank system is placed into service. Additionally, the installer is responsible for inspecting and testing the overfill-prevention equipment, line leak detectors and all valves installed to control product flow to verify the safety of the system.

2. Test all system components, piping, tanks, dispensers, etc for complete and correct system operation and demonstrate to owner prior to the system being placed in operation.

3. All testing shall be in compliance with NFPA 30 and 30a requirements.

C. Tank:

1. Tanks are to be factory tested prior to shipment and field tested prior to system start-up.
2. Air pressure test both the primary and secondary tank in accordance with the tank manufacturer’s recommendations. In addition to the pressure test, cover the entire tank surface, manways and all fittings with soap solution and inspect for leaks.
3. There shall be no drop in pressure.

4. Fill containment sump/turbine enclosure with water. There shall be no drop in the alter level after four hours.
5. Tank to be tested with air pressure not less than a gauge pressure of 3 psi and not more than a gauge pressure of 5 psi for two hours.
6. The interstitial space shall be air tested at a gauge pressure of 3 psi to 5 psi, by vacuum, or in accordance with the tank's listing of the manufacturer's instructions.

D. Piping:

1. Test aboveground piping at 150% of operating pressure but no less than 50 psig air pressure for two hours. Soap all joints.
2. Before backfilling and after assembly, but before connection to equipment , air test all underground primary piping at 150% of operating pressure but no less than 50 psig for two hours. Soap all joints.
3. Test secondary containment piping per pipe manufacturer's requirements but no less than 5 psig. Soap all joints.
4. There shall be no drop in pressure.

E. Monitoring and Leak Detection Systems:

1. Test and adjust tank monitor and leak detection systems and devices per manufacturer's directions.

F. Final Test:

1. Conduct precision test of all piping, tanks, and equipment in compliance with EPA and Connecticut Department of energy and environmental protection requirements. Test after piping has been completed but before paving and the system is placed in operation.
2. The test shall be conducted using leak detection methods approved by Connecticut Department of energy and environmental protection .

G. Test Results:

1. Provide written certification of all test results to the Owner and Engineer.

H. Final acceptance
1. All tanks to be completely filled with product for acceptance by the state.

3.9 RECORD PHOTOGRAPHS

A. After installation, but before backfilling, take photographs of the following:

1. Each tank assembly
2. Underground piping.
3. Two (2) general views of entire length of run of each piping assembly, including tanks.

B. Submit two (2) copies of each, 8-1/2 in. x 11 in. color prints of above, properly identified.

3.10 RECORD DRAWINGS

A. Provide two sets of as-built AutoCAD drawings 2008 or newer plans that show the size and locations of the tank, equipment, and piping system. These plans must include a statement by the installer that the system has been installed in compliance with all Connecticut State codes, National codes, Department of Health codes, DOT codes, and NFPA requirements.

3.11 TRAINING

A. Instruct Owner's personnel in complete and proper use, operation, and daily maintenance of all system equipment components, including dispenser/tank components, leak detection system, and chipkey reader hardware. Review emergency provisions, including procedures to be followed at time of operational failure. Provide contact names and telephone numbers on labels on each type of equipment. Train Owner's personnel in procedures to follow in identifying sources of operational failures or malfunctions. Confer with Owner on requirements for a complete fueling equipment maintenance program. Training shall be for not less than 8 hours with a factory authorized representative.

B. Provide a minimum of four hours of training related to the leak detection tank monitoring system. The training shall be provided by a certified level technician who install and programmed the equipment.

END OF SECTION 111560

SECTION 115700- COMPRESSED-AIR EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes the following compressed-air equipment and related accessories:

1. Air compressors and receivers.
2. Compressed-air dryers.
3. Compressed-air filter assemblies.

B. Related Sections include the following:

1. Division 11 Section "General Service Compressed-Air Piping" for compressed-air piping, valves, and related specialties.

1.3 DEFINITIONS

A. Actual Air: Air delivered from air compressors. Flow rate is delivered compressed air measured in acfm.

B. Standard Air: Free air at 68 deg F and 1 atmosphere (29.92 in. Hg) before compression or expansion and measured in scfm.

1.4 QUALITY ASSURANCE

A. All components shall be factory tested and documented to operate as a complete system

B. Manufacturer's Representative: The manufacturer authorized representative shall be factory trained and certified personnel providing service, startup, and quality control field labor for the project from their local office.
1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out and start up.
2. Training: Provide technical representative to train Owner's maintenance personnel in operation and maintenance of specified equipment

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. ASME Compliance: Fabricate and label receiver tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. Comply with NFPA 70, "National Electrical Code

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following compressed-air equipment:

1. Air compressors, including receivers and intake filters.
2. Compressed-air dryers.
3. Compressed-air filter assemblies.

C. Shop Drawings: Signed and sealed by a qualified professional engineer.
1. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
2. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Wiring Diagrams: Power, signal, and control wiring.

D. Product Certificates: Certificates of shop inspection and data report for receiver tanks as required by ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.6 INFORMATION SUBMITTALS

A. Factory tests and inspection reports prior to shipping.

B. Field test and start-up reports, indicating and interpreting test results relative to compliance with specified requirements, for information

C. Certificates: For certification required in "Quality Assurance" Article

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For the equipment identified to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Belts: One set(s) for each belt-driven unit
   2. Filters: one set for each unit containing a filter

1.9 WARRANTY

A. Warrant work specified herein for two years from substantial completion against defects in materials, function and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough, or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.

D. All parts shall be readily available locally in the United States.

E. Any units or parts which prove defective during the warranty period will be replaced with OEM parts and transportation prepaid

1.10 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid, dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Mark Number of this specification.

C. Provide equipment and materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

1.11 LABELING

A. Nameplate: Manufacturer shall securely attach in a prominent location on each major item of equipment a non-corrosive nameplate with stamped figures showing manufacturer's name, address, model number, serial number and pertinent utility or operating data.

B. Lifting capacity shall be painted with letters and numbers 3 inches high Minimum on both sides of lifting mast assembly.

C. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (U.L.), or other National Recognized Testing Laboratory (NRTL), in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant

1.12 COORDINATION

A. Coordinate size and location of concrete bases. Refer to Division 3 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete requirements.

PART 2 - PRODUCTS

2.1 PACKAGED AIR COMPRESSORS AND RECEIVERS

A. Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.

B. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1; rated for working pressure at least as high as highest discharge pressure of connected compressors; and bearing appropriate code symbols. Include safety valve, pressure gage, automatic drain, and pressure-reducing valve.

C. Rotary screw compressor.

1. Manufacturers
   a. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Atlas Copco

2. Compressor(s): Freestanding, full featured oil-flooded, rotary helical-screw type with lubricated helical screws and lubricated gear box.
   a. Mounting: Freestanding.
   b. Inlet air filter: high duct, two stage dry-type air cleaner, 99.9% efficient at 3 microns and above. Provide a pressure differential sensor.
   c. Rotor shafts: precision ground to tolerances within 12 microns. Rotor housing to be made of high quality, cose grain cast iron.
   d. Bearings: Tapered roller thrust bearings. Thrust bearing housing to be made of close grain cast iron.
      1) Provide high quality cylindrical roller bearings to carry radial loads on the inlet end of the rotors.
   e. Compressor to be provided with coolant dams at the duplex tapered roller bearing locations to immediately lubricate bearings when compressor starts.
   f. Shaft seal: triple lip fitted to the male rotor.
   g. Main drive motor- low speed four pole matched to the requirements of the compressor.
      1) Motor frame- Standard NEMA 1, 4 pole EISA open drip proof motors.
      2) Motor beatings: Vacuum degassed ball bearings for the drive end and non-drive end, grease lubricated rated for 18,000 hour service before re-lubrication.
      3) Motor insulation: Class F capable of operating in conditions up to 104 degrees F.
   h. Belt drive: Non-overloading, automatic belt tension control designed to eliminate bearing overload.
      1) Provide protective enclosure to contain complete drive system

i. Coolant system-
   1) Coolant filtration- high capacity 5-micron, replaceable spin-on element with pressure bypass.
   2) Coolant/lubrication temperature control: accomplished through use of a thermostatic control valve mounted downstream of the oil cooler to control the flow of coolant through the oil cooler.

j. Provide integral dryer and coolant/air separation: accomplished through use of a three stage separation system.
   1) Provide air-cooled aftercooler to further cool the compressed air.
   2) The separator tank is mounted horizontally and is close coupled to the air end forming one module.
   3) Provide a pressure relief valve on the tank to protect the separator vessel.
   4) Provide a drain at the bottom of the tank and a coolant filler point.
   5) Provide a coolant level indicator.
   6) Provide a combined minimum pressure/check valve regulator to regulate the air discharge from the separator.
   7) Provide compressor with required coolant, factory filled.

k. Cooling system:
   1) Provide integral mounted air-cooled heat exchanger to cool both the coolant and compressed air. Cooler to be of tube and fin design, constructed from aluminum and designed to operate in ambient temperatures from 35 degrees F up to 104 degrees F. The after cooler is to cool the compressed air prior to discharge from compressor package.

l. Provide a motor driven low speed centrifugal cooling fan mounted in an internal segregated cooling compartment and discharge from a single point at the top of the unit. Provide a filter panel to pre-filter the cooling air. The cooling fan to be capable of up to ½" water gauge static pressure.

m. Provide moisture separator and drain directly downstream of the after cooler.

n. Piping: Provide flexible SAE hoses and JIC fittings, rigid steel piping, Bundy weld tubing, flexible connectors and nylon tubing as required to provide vibration free operation. Provide SAE O ring fittings on all connection larger than 3/8".

o. Controls:
   1) Provide advanced microprocessor control module to provide starting, stopping, capacity and pressure control, together with operating and safety control for the package.
   2) Instrument panel to be mounted on the front of the compressor, directly above the starter. The control panel to include:
      a) Run/stop selector switch and reset button
      b) "lock off" emergency stop button
      c) Pressure gauge
      d) Running hour meter
      e) Signal light for: power on (green), auto reset (white), common alarm (red).
      f) Dryer on/off switch
      g) Dew point indicator
   3) Provide with online/offline auto start and stop. Online/offline to allow compressor to operate at 2 points. The first is 100% full flow and the second is no flow.
   4) Controls to provide unload operation for immediate compressor internal system blow-down to minimize power requirements.

5) The system will automatically reload to 100% capacity when the system falls to the online pressure setting.
6) Provide with automatic stop/start with run time to allow the compressor to run unloaded for a predetermined time. If there is not demand within that period the unit shuts down to standby and will automatically restart and reload in the system pressure falls to the online pressure settings.

p. Starter: Provide a integrally mounted full voltage starter in a NEMA 4 enclosure with a transformer to accommodate control voltage.
1) Motor overload protection to be designed and sized to match the specific characteristic of the motor.

q. Temperature protection: Should the temperature exceed 228 degrees F at the air end discharge the controller will shut down the compressor and illuminate the fault indicator.

r. Baseplate: One piece folded or fabricated steel to support all of the components. Provide high grade powder coat finish. Baseplate to be provided with fork lift slots.

s. Enclosure: Designed to provide effective sound emission control and suppression.
1) Front door to be hinged to the side and can lift off if required to provide easy access to all routine maintenance points as follows:
a) Check and add coolant
b) Check intake filter condition and change
c) Check coolant filter and change
d) Change separator cartridge
e) Service intake valve
f) Service load solenoid valve
g) Service blow down solenoid valve
h) Drain and refill coolant
i) Set and adjust load and unload operating pressures.
2) Starter to be accessed through a single front mount door.

t. Provide with power out reset to safely return the compressor to the original operating condition following the interruption of power supply.

u. Provide with separate vertical remote receiver with external coating. Provide with drain valve kit.

v. Compressor to be provided with the following components:
1) Pre-filter
2) Automatic drain valve
3) Condensate drain
4) Moisture separator drain
5) Dryer drain
6) Air filter drain

D. Miscellaneous Devices: Provide safety valves, discharge-air pressure gages, pressure regulators, and shutoff valves.

2.2 ACCESSORIES

A. General: Include accessories with working-pressure rating not less than system pressure at location where used, and compatible with equipment and piping system used.

2.3 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet safety valve for compressed-air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Automatic Drain Valves: Electrical- or mechanical operation type with corrosion-resistant metal body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate.

C. Pressure Regulators: Bronze body, direct acting, spring loaded, manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.

PART 3 - EXECUTION

3.1 CONCRETE BASES

A. Install concrete bases for compressed-air equipment. concrete materials and installation requirements are specified in Division 3.

3.2 EQUIPMENT INSTALLATION

A. Install air compressors on concrete bases. Install units level, plumb, and anchored to substrate in locations indicated. Maintain manufacturers' recommended clearances. Orient equipment so controls and devices are accessible for servicing.

1. Anchor packaged equipment to concrete base.

a. Install epoxy-coated anchor bolts for supported equipment; extend through concrete base and anchor into structural concrete floor.
b. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
c. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Maintain manufacturer's recommended clearances for service and maintenance.

C. Install the following devices on compressed-air equipment:

1. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
2. Pressure Regulators: Install downstream from air compressors, dryers, purification units, and filter assemblies.
3. Automatic Drain Valves: Install on intercoolers, aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

4. Install shut-off valves and pressure gauges on compressor discharge and receiver discharge.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 11 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Connect piping to air compressors and receivers, except safety relief valve connections, with flexible pipe connectors of materials suitable for service.

D. Ground equipment according to Division 26 Section "Grounding and Bonding."

E. Connect wiring according to Division 26 Section "Conductors and Cables."

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for compressed-air equipment.

3.5 TESTING

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to start-up inspect, test, and adjust components, assemblies, and equipment installations, including connections, check operation of the equipment and components for operation and performance as specified and examine the finish for damage. Provide report in writing that the installation meets the requirements and shall include information concerning minor adjustments and minor repairs, which may be required before final acceptance by the Owner.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Perform the following final checks:

   1. Verify that specified tests of piping systems are complete.
   2. Check for piping connection leaks.
   3. Check for lubricating oil in lubricated-type equipment.
   4. Check belt drives for proper tension.
   5. Verify that air-compressor inlet filters and piping are clear.
   6. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.

7. Check safety valves for correct settings. Ensure that settings are greater than air-compressor discharge pressure but not greater than rating of system components.
8. Test operation of equipment safety controls and devices.
9. Drain receiver tanks.

D. Verify that compressed-air equipment is installed and connected according to the Contract Documents.

E. Verify that electrical wiring installation complies with manufacturer's submittal and written installation requirements in Division 26 Sections.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Complete installation and startup checks according to manufacturer's written instructions.

I. Prepare written report documenting testing procedures and results.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain compressed-air equipment.

END OF SECTION 115700

SECTION 115710- BREATHING AIR SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes the following compressed-air equipment and related accessories:

1. Air compressors and receivers.
2. Breathing air system
3. Compressed-air dryers.
4. Compressed-air filter assemblies.

B. Related Sections include the following:

1. Division 11 Section "General Service Compressed-Air Piping" for compressed-air piping, valves, and related specialties.

2. Division 11 Section "Breathing Air Piping" for breathing air piping, valves, and related specialties.

1.3 DEFINITIONS

A. Actual Air: Air delivered from air compressors. Flow rate is delivered compressed air measured in acfm.

B. Standard Air: Free air at 68 deg F and 1 atmosphere (29.92 in. Hg) before compression or expansion and measured in scfm .

1.4 QUALITY ASSURANCE

A. All components shall be factory tested and documented to operate as a complete system

B. Manufacturer's Representative: The manufacturer authorized representative shall be factory trained and certified personnel providing service, startup, and quality control field labor for the project from their local office.
1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out and start up.
2. Training: Provide technical representative to train Owner's maintenance personnel in operation and maintenance of specified equipment

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. ASME Compliance: Fabricate and label receiver tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. Comply with NFPA 70, "National Electrical Code

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following compressed-air equipment:

1. Air compressors, including receivers and intake filters.
2. Breathing air systems
3. Compressed-air dryers.
4. Compressed-air filter assemblies.

C. Shop Drawings: Signed and sealed by a qualified professional engineer.
1. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
2. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Wiring Diagrams: Power, signal, and control wiring.

1.6 INFORMATION SUBMITTALS

A. Product Certificates: Certificates of shop inspection and data report for receiver tanks as required by ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

B. Factory tests and inspection reports prior to shipping.

C. Field test and start-up reports, indicating and interpreting test results relative to compliance with specified requirements, for information

D. Certificates: For certification required in "Quality Assurance" Article

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For the equipment identified to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Belts: One set(s) for each belt-driven unit
   2. Filters: one set for each unit containing a filter

1.9 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, function and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough, or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.

D. All parts shall be readily available locally in the United States.

E. Any units or parts which prove defective during the warranty period will be replaced with OEM parts and transportation prepaid

1.10 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid, dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Mark Number of this specification.

C. Provide equipment and materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

1.11 LABELING

A. Nameplate: Manufacturer shall securely attach in a prominent location on each major item of equipment a non-corrosive nameplate with stamped figures showing manufacturer's name, address, model number, serial number and pertinent utility or operating data.

B. Lifting capacity shall be painted with letters and numbers 3 inches high Minimum on both sides of lifting mast assembly.

C. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (U.L.), or other National Recognized Testing Laboratory (NRTL), in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant

1.12 COORDINATION

A. Coordinate size and location of concrete bases. Refer to Division 3 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete requirements.

PART 2 - PRODUCTS

2.1 PACKAGED AIR COMPRESSORS AND RECEIVERS

A. Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.

B. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1; rated for working pressure at least as high as highest discharge pressure of connected compressors; and bearing appropriate code symbols. Include safety valve, pressure gage, automatic drain, and pressure-reducing valve

C. Rotary screw compressor- Maintenance Building (Paint booth)

1. Manufacturers
   a. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Atlas Copco

2. Compressor(s): Freestanding, full featured oil-flooded, rotary helical-screw type with lubricated helical screws and lubricated gear box.
   a. Mounting: Freestanding.
   b. Inlet air filter: high duct, two stage dry-type air cleaner, 99.9% efficient at 3 microns and above. Provide a pressure differential sensor.
   c. Rotor shafts: precision ground to tolerances within 12 microns. Rotor housing to be made of high quality, cose grain cast iron.
   d. Bearings: Tapered roller thrust bearings. Thrust bearing housing to be made of close grain cast iron.
      1) Provide high quality cylindrical roller bearings to carry radial loads on the inlet end of the rotors.
   e. Compressor to be provided with coolant dams at the duplex tapered roller bearing locations to immediately lubricate bearings when compressor starts.
   f. Shaft seal: triple lip fitted to the male rotor.
   g. Main drive motor- low speed four pole matched to the requirements of the compressor.
      1) Motor frame- Standard NEMA 1, 4 pole EISA open drip proof motors.
      2) Motor beatings: Vacuum degassed ball bearings for the drive end and non-drive end, grease lubricated rated for 18,000 hour service before re-lubrication.
      3) Motor insulation: Class F capable of operating in conditions up to 104 degrees F.
   h. Belt drive: Non-overloading, automatic belt tension control designed to eliminate bearing overload.
      1) Provide protective enclosure to contain complete drive system

i. Coolant system-
   1) Coolant filtration- high capacity 5-micron, replaceable spin-on element with pressure bypass.
   2) Coolant/lubrication temperature control: accomplished through use of a thermostatic control valve mounted downstream of the oil cooler to control the flow of coolant through the oil cooler.

j. Provide integral dryer and coolant/air separation: accomplished through use of a three stage separation system.
   1) Provide air-cooled aftercooler to further cool the compressed air.
   2) The separator tank is mounted horizontally and is close coupled to the air end forming one module.
   3) Provide a pressure relief valve on the tank to protect the separator vessel.
   4) Provide a drain at the bottom of the tank and a coolant filler point.
   5) Provide a coolant level indicator.
   6) Provide a combined minimum pressure/check valve regulator to regulate the air discharge from the separator.
   7) Provide compressor with required coolant, factory filled.

k. Cooling system:
   1) Provide integral mounted air-cooled heat exchanger to cool both the coolant and compressed air. Cooler to be of tube and fin design, constructed from aluminum and designed to operate in ambient temperatures from 35 degrees F up to 104 degrees F. The after cooler is to cool the compressed air prior to discharge from compressor package.

l. Provide a motor driven low speed centrifugal cooling fan mounted in an internal segregated cooling compartment and discharge from a single point at the top of the unit. Provide a filter panel to pre-filter the cooling air. The cooling fan to be capable of up to ½" water gauge static pressure.

m. Provide moisture separator and drain directly downstream of the after cooler.

n. Piping: Provide flexible SAE hoses and JIC fittings, rigid steel piping, Bundy weld tubing, flexible connectors and nylon tubing as required to provide vibration free operation. Provide SAE O ring fittings on all connection larger than 3/8".

o. Controls:
   1) Provide advanced microprocessor control module to provide starting, stopping, capacity and pressure control, together with operating and safety control for the package.
   2) Instrument panel to be mounted on the front of the compressor, directly above the starter. The control panel to include:
      a) Run/stop selector switch and reset button
      b) "lock off" emergency stop button
      c) Pressure gauge
      d) Running hour meter
      e) Signal light for: power on (green), auto reset (white), common alarm (red).
      f) Dryer on/off switch
      g) Dew point indicator
   3) Provide with online/offline auto start and stop. Online/offline to allow compressor to operate at 2 points. The first is 100% full flow and the second is no flow.
   4) Controls to provide unload operation for immediate compressor internal system blow-down to minimize power requirements.

5) The system will automatically reload to 100% capacity when the system falls to the online pressure setting.
6) Provide with automatic stop/start with run time to allow the compressor to run unloaded for a predetermined time. If there is not demand within that period the unit shuts down to standby and will automatically restart and reload in the system pressure falls to the online pressure settings.

p. Starter: Provide a integrally mounted full voltage starter in a NEMA 4 enclosure with a transformer to accommodate control voltage.
1) Motor overload protection to be designed and sized to match the specific characteristic of the motor.

q. Temperature protection: Should the temperature exceed 228 degrees F at the air end discharge the controller will shut down the compressor and illuminate the fault indicator.

r. Baseplate: One piece folded or fabricated steel to support all of the components. Provide high grade powder coat finish. Baseplate to be provided with fork lift slots.

s. Enclosure: Designed to provide effective sound emission control and suppression.
1) Front door to be hinged to the side and can lift off if required to provide easy access to all routine maintenance points as follows:
a) Check and add coolant
b) Check intake filter condition and change
c) Check coolant filter and change
d) Change separator cartridge
e) Service intake valve
f) Service load solenoid valve
g) Service blow down solenoid valve
h) Drain and refill coolant
i) Set and adjust load and unload operating pressures.
2) Starter to be accessed through a single front mount door.

t. Provide with power out reset to safely return the compressor to the original operating condition following the interruption of power supply.

u. Compressor, controller and dryer to be factory mounted on air receiver.

v. Compressor to be provided with the following components:
1) Pre-filter
2) Automatic drain valve
3) Condensate drain
4) Moisture separator drain
5) Dryer drain
6) Air filter drain

w. Breathing air system: The system shall be completely assembled, piped, wired, and tested. All system components shall be skid-mounted and shall include water separator, pre- and fine coalescing filters receiver, dryer/purifier, CO converter, bacteria filter, control and monitor system.
1) Code Compliance Requirements: The compressed breathing air purification system shall cool, clean, filter, and purify ordinary compressed air in compliance with national, state and breathing air standards including:
a) OSHA Regulations: 29 CFR 1910.134 “Respiratory Protection Air Quality”.
b) Compressed Gas Association Pamphlet G-7, “Compressed Air For Human Respiration”, and Pamphlet G7.1 “Commodity Specification for Air”.

c) NIOSH/EPA Document EPA-560-OPTS86-01: “A Guide to Respirator Protection for the Abatement Industry” Part IV and Appendix F.

d) American National Standard Z88.2-1080 “Practices for Respiratory Protection”

2) Provide modular desiccant dryer: High efficiency integral pre-filtration with dust removal after-filtration and desiccant bed absorption to provide clean, dry air at dryer outlet.

a) Capacity: 20 scfm

b) Dewpoint: -40 degree F, ISO class 1 dewpoint performance

c) Refrigerant: molecular service desiccant

d) Maximum operating pressure: 175 psig

e) Dimensions: 11.4”W x 6”D x 43.2”H

3) Wall mounted CO removal system:

a) Rated airflow (max) at 100 psi: 50 scfm

b) Monitor both carbon monoxide and oxygen levels.

c) Designed to operate continuously.

d) Operating pressure: 100 psig dynamic

e) Inlet pressure: 150 psig static

f) Outlet pressure range: 0-125 psig

g) Operating temperature range: 68-150 degrees F

h) Operating relative humidity: 30-100%

i) Provide with replacement filter set

j) System components: Ball valve at inlet to facilitate filter changing operations; Pre-filter, deep charcoal bed for removal of gaseous hydrocarbons, tastes, and orders; Deep bed of low temperature catalyst for removing carbon monoxide and other toxic gases; flow meter; pressure relief valve; High flow regulator with gauge to adjust main outlet air supply; Rugged panel board; Carbon monoxide monitor with remote alarm and strobe.

4) Additional breathing air purification system requirements.

a) Failure to shift alarm.

b) Carbon monoxide monitor.

c) Low pressure alarm.

d) High temperature alarm.

e) Audible alarm horn.

5) Coalescing Filters: Capacity not less than that of connected equipment; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Equip with activated carbon capable of removing water and oil aerosols.

6) Provide quick disconnect fittings for all breathing system outlets shall be Schrader 3/4" twist lock type. Outlets shall be 303 stainless steel construction. (See drawings for connections and locations.)

7) Provide two 30 ft. and two 50 ft. breathing air hoses for booth. Each hose shall be provided with a full face respirator with complete pressure control assembly ready for use. Regulators and hoses to be mounted to man-lifts.

D. Miscellaneous Devices: Provide safety valves, discharge-air pressure gages, pressure regulators, and shutoff valves.

2.2 ACCESSORIES

A. General: Include accessories with working-pressure rating not less than system pressure at location where used, and compatible with equipment and piping system used.

2.3 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet safety valve for compressed-air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Automatic Drain Valves: Electrical- or mechanical operation type with corrosion-resistant metal body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate.

C. Pressure Regulators: Bronze body, direct acting, spring loaded, manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.

PART 3 - EXECUTION

3.1 CONCRETE BASES

A. Install concrete bases for compressed-air equipment. concrete materials and installation requirements are specified in Division 3.

3.2 EQUIPMENT INSTALLATION

A. Install air compressors on concrete bases. Install units level, plumb, and anchored to substrate in locations indicated. Maintain manufacturers' recommended clearances. Orient equipment so controls and devices are accessible for servicing.

1. Anchor packaged equipment to concrete base.

a. Install epoxy-coated anchor bolts for supported equipment; extend through concrete base and anchor into structural concrete floor.
b. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
c. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Maintain manufacturer's recommended clearances for service and maintenance.

C. Install the following devices on compressed-air equipment:

1. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
2. Pressure Regulators: Install downstream from air compressors, dryers, purification units, and filter assemblies.
3. Automatic Drain Valves: Install on intercoolers, aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.
4. Install shut-off valves and pressure gauges on compressor discharge and receiver discharge.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 11 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Connect piping to air compressors and receivers, except safety relief valve connections, with flexible pipe connectors of materials suitable for service.

D. Ground equipment according to Division 26 Section "Grounding and Bonding."

E. Connect wiring according to Division 26 Section "Conductors and Cables."

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for compressed-air equipment.

3.5 TESTING

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to start-up inspect, test, and adjust components, assemblies, and equipment installations, including connections, check operation of the equipment and components for operation and performance as specified and examine the finish for damage. Provide report in writing that the installation meets the requirements and shall include information concerning minor adjustments and minor repairs, which may be required before final acceptance by the Owner.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Perform the following final checks:

   1. Verify that specified tests of piping systems are complete.
   2. Check for piping connection leaks.

3. Check for lubricating oil in lubricated-type equipment.
4. Check belt drives for proper tension.
5. Verify that air-compressor inlet filters and piping are clear.
6. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
7. Check safety valves for correct settings. Ensure that settings are greater than air-compressor discharge pressure but not greater than rating of system components.
8. Test operation of equipment safety controls and devices.
9. Drain receiver tanks.

D. Verify that compressed-air equipment is installed and connected according to the Contract Documents.

E. Verify that electrical wiring installation complies with manufacturer's submittal and written installation requirements in Division 26 Sections.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Complete installation and startup checks according to manufacturer's written instructions.

I. Prepare written report documenting testing procedures and results.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain compressed-air equipment.

END OF SECTION 115710

SECTION 115720 - GENERAL-SERVICE COMPRESSED-AIR PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes piping and related specialties for general-service compressed-air systems operating at 200 psig or less.

B. Related Sections include the following:

1. Section 115700 "Compressed Air Equipment" for general-service air compressors and accessories.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. CR: Chlorosulfonated polyethylene synthetic rubber.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. HDPE: High-density polyethylene plastic.

E. NBR: Acrylonitrile-butadiene rubber.

F. PE: Polyethylene plastic.

G. PVC: Polyvinyl chloride plastic.

H. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig (1035 kPa) or less.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. Product Data: For the following:
1. Dielectric fittings.
2. Valves

3. Flexible pipe connectors.
4. Safety valves.
5. Pressure regulators. Include rated capacities and operating characteristics.
6. Automatic drain valves.
7. Filters. Include rated capacities and operating characteristics.
8. Quick couplings.
9. Hose assemblies.

C. Provide piping schedule indicating type of intended installation and installation location. Refer to piping schedule below.

D. Shop/Coordination Drawings: Produced in electronic format (compatible with Autocad 2008) Detailed at ¼" =1'-0" scale, double lined. Drawings shall indicate pipe layout and elevation, and all equipment with manufacturers' recommended maintenance access. The following items shall be shown and coordinated with each other, using input from installers of the items and trades involved: (Submit 3 hard copies of all documents to Architect for Review and Approval):

1. Piping installation in all spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to piping layout.
2. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
3. Fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides.
4. Detail location of anchors, alignment guides, and expansion joints and loops.
5. Piping layout indicating sizes, configuration, and service.
6. Elevation of top of pipes.
7. Pipe fittings.
8. Reinforcement and spacing.
9. Structural members to which piping will be attached.
10. Hose reels and connection detail to reels.
11. Piping arrangement and connections to equipment
12. Compressed air equipment including compressors and receivers.
13. Location for filters and regulators.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Qualification Data: For Installers.

C. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

B. ASME Compliance:
   1. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Schedule 40, Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, black coated with ends threaded according to ASME B1.20.1.

   1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.
   2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.
   3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.
   4. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel, threaded.
   5. Wrought-Steel Butt-Welding Fittings: ASME B16.9, Schedule 40.
   6. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.

2.2 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for compressed-air piping system contents.

   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hammond Valve.
      b. Milwaukee Valve Company.
      c. NIBCO INC.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Forged brass.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full.

2.4 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.; Apollo Valves.
   b. Milwaukee Valve Company.
   c. NIBCO INC.

2. Description:

   a. Standard: MSS SP-70, Type I.
   b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
   c. Body Material: ASTM A 126, gray iron with bolted bonnet.
   d. Ends: Flanged.
   e. Trim: Bronze.
   f. Disc: Solid wedge.
   g. Packing and Gasket: Asbestos free

2.5 FLEXIBLE PIPE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.
2. Metraflex, Inc.
3. Proco Products, Inc.

B. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: 200 psig minimum.
2. End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.
3. End Connections, NPS 2-1/2 and Larger: Flanged steel nipple.

2.6 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.

1. Type: Pilot operated.

C. Air-Line Pressure Regulators: Diaphragm or pilot operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.

D. Automatic Drain Valves: Stainless-steel body and internal parts, rated for **200-psig** minimum working pressure, capable of automatic discharge of collected condensate.

E. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock

2.7 QUICK COUPLINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aeroquip Corporation; Eaton Corp.
2. Foster Manufacturing, Inc.
3. Milton Industries, Inc.

B. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.

C. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.

1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
2. Plug End: Flow-sensor-bleeder, check-valve type with barbed outlet for attaching hose.

D. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.

1. Socket End: With O-ring or gasket seal, without valve, and with barbed inlet for attaching hose.
2. Plug End: With barbed outlet for attaching hose

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Compressed-Air Piping between Air Compressors and Receivers: Use the following piping materials for each size range:

1. NPS 2 and Smaller: Schedule 40, black-steel pipe; threaded, malleable-iron fittings; and threaded joints.
2. NPS 2-1/2 to NPS 4- provide one of the following
   a. Schedule 40, black-steel pipe; wrought-steel welded fittings; and welded joints.
   b. Schedule 40, black-steel flanged fittings and joints.

B. Low-Pressure Compressed-Air Distribution Piping: Use one of the following piping materials for each size range:

1. NPS 2 and Smaller: Schedule 40, black-steel pipe; threaded, malleable-iron fittings; and threaded joints.
2. NPS 2-1/2 to NPS 4- provide one of the following
   a. Schedule 40, black-steel pipe; wrought-steel welded fittings; and welded joints.
   b. Schedule 40, black-steel flanged fittings and joints

3.2 VALVE APPLICATIONS

A. Pipe NPS 2 and smaller:
   1. Brass Ball Valves: Threaded ends, two piece, full port, brass with brass trim

B. Pipe NPS 2-1/2 and Larger:
   1. Iron Gate Valves: Flanged pipe fitting installation, Class 125 NRS

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.

E. Install piping adjacent to equipment and machines to allow service and maintenance.

F. Install air and drain piping with 1 percent slope downward in direction of flow.

G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.

H. Equipment and Specialty Flanged Connections:

1. Use steel companion flange with gasket for connection to steel pipe.

I. Flanged joints may be used instead of specified joint for any piping or tubing system.

J. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

K. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

L. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver.

M. Install piping to permit valve servicing.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install sleeves for piping penetrations of walls, ceilings, and floors.

Q. Install sleeve seals for piping penetrations of concrete walls and slabs.

R. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints for Steel Piping: Join according to AWS D10.12/D10.12M.

E. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.

F. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.5 VALVE INSTALLATION

A. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.

B. Install shutoff valve at inlet to each automatic drain valve, filter, and pressure regulator.

C. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

3.6 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. NPS 2 and Smaller: Use dielectric unions.

C. NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.7 FLEXIBLE PIPE CONNECTOR INSTALLATION

A. Install stainless steel flexible pipe connectors in discharge piping of each air compressor.

B. Install stainless steel flexible pipe connectors at connection to each hose reel.

3.8 SPECIALTY INSTALLATION

A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.

B. Install air-main pressure regulators in compressed-air piping at or near air compressors.

C. Install air-line pressure regulators in branch piping as indicated on drawings.

D. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate onto nearest floor drain.

E. Install mechanical filters in compressed-air piping as indicated on drawings. Mount on wall at locations indicated.

F. Install quick couplings at piping terminals for hose connections.

G. Install hose assemblies at hose connections.

3.9 CONNECTIONS

A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.

B. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment and machine.

3.10 HANGER AND SUPPORT INSTALLATION

A. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet or Less: MSS Type 1, adjustable, steel clevis hangers.
2. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

B. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

C. Base of Vertical Piping: MSS Type 52, spring hangers.

D. Support horizontal piping within 12 inches of each fitting and coupling.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

F. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4 to NPS 1/2 : 96 inches with 1/2-inch rod.
2. NPS 3/4 to NPS 1-1/4: 84 inches with 1/2-inch rod.
3. NPS 1-1/2: 12 feet with 1/2-inch rod.
4. NPS 2: 13 feet with 1/2-inch rod.
5. NPS 2-1/2: 14 feet with 1/2-inch rod.
6. NPS 3: 15 feet with 1/2-inch rod.
7. NPS 4: 17 feet with 5/8-inch rod.

G. Install supports for vertical, Schedule 40, steel piping every 10 feet .

3.11 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties.

3.12 PAINTING

A. Comply with requirements in Section 099100 "Painting" for painting interior piping.

B. Paint exposed, interior metal piping with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.

    a. Prime Coat: Alkyd anticorrosive or Quick-drying alkyd metal primer.
    b. Intermediate Coat: Interior latex matching topcoat.
    c. Topcoat: Interior latex semigloss.
    d. Color:
        1) Compressed air: Green

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish

3.13 FIELD QUALITY CONTROL

A. Perform field tests and inspections.

B. Tests and Inspections:

1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 180 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
2. Repair leaks and retest until no leaks exist.
3. Inspect pressure regulators for proper operation.

C. Prepare test reports

END OF SECTION 115720

SECTION 115721 – BREATHING AIR PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Breathing-air piping, designated "breathing air."

B. Related Requirements:
1. Section 115700 "Compressed-Air Equipment for air compressors and specialties”.
2. Section 115710 "Breathing Air System”

1.3 DEFINITIONS

A. Breathing air piping systems include piping from the outlet of the breathing air purifier to the paint booth.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. Product Data: For each type of product.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Medical Air Piping Systems for Healthcare Facilities: According to ASSE Standard #6010 for medical-gas-system installers.

B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Breathing air operating at 60 psig.

2.2 PIPES, TUBES, AND FITTINGS

A. Copper Medical Gas Tube: ASTM B 819, Type L, seamless, drawn temper, that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in blue for Type L tube.

B. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.

C. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.

D. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.

1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness, full-face type.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

E. Shape-Memory-Metal Couplings:
1. Description: Cryogenic compression fitting made of nickel-titanium, shape-memory alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1

F. Flexible Pipe Connectors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Flex-Hose Co., Inc.
b. Metraflex Company (The).
c. Unaflex.

2. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

a. Working-Pressure Rating: 200 psig minimum.
b. End Connections: Plain-end copper tube.

2.3 JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys.

2.4 VALVES

A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amico Corporation.
   b. Conbraco Industries, Inc.
   c. NIBCO INC.

2. Standard: MSS SP-110.
3. Description: Three-piece body, brass or bronze.
4. Pressure Rating: 300 psig minimum.
5. Ball: Full-port, chrome-plated brass.
6. Seats: PTFE or TFE.
7. Handle: Lever type. Provide Lever type with locking device for source and service valves. Zone valves to be provided without locking device.
8. Stem: Blowout proof with PTFE or TFE seal.
9. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions and manufacturer-installed ASTM B 819, copper-tube extensions.

C. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amico Corporation.
   b. Conbraco Industries, Inc.
   c. NIBCO INC.

2. Description: In-line pattern, bronze.
3. Pressure Rating: 300 psig minimum.
4. Operation: Spring loaded.
5. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

D. Safety Valves:

1. Bronze body.
2. ASME-construction, poppet, pressure-relief type.
3. Settings to match system requirements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Cleaning of Breathing Air Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if pre-cleaned fittings or tubing must be re-cleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:

1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1.
2. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.

    a. Scrub to ensure complete cleaning.
    b. Rinse with clean, hot water to remove cleaning solution.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

C. Install piping adjacent to equipment and specialties to allow service and maintenance.

D. Install breathing-air piping with 1 percent slope downward in direction of flow.

E. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.

F. Install eccentric reducers, if available, where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

G. Install branch connections to breathing-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

H. Install piping to permit valve servicing.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and for branch connections.

K. Install unions in copper compressed-air tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.

3.3 VALVE INSTALLATION

A. Install shutoff valve at each connection to and from breathing air equipment and specialties.

B. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.

C. Install pressure regulators on compressed-air piping where reduced pressure is required.

3.4 JOINT CONSTRUCTION

A. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.

B. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

3.5 HANGER AND SUPPORT INSTALLATION

A. Vertical Piping: MSS Type 8 or Type 42, clamps.

B. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
2. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.

C. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.

D. Base of Vertical Piping: MSS Type 52, spring hangers.

E. Support horizontal piping within 12 inches of each fitting and coupling.

F. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch- minimum rods.

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4: 60 inches with 3/8-inch rod.
2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
3. NPS 3/4: 84 inches with 3/8-inch rod.
4. NPS 1: 96 inches with 3/8-inch rod.
5. NPS 1-1/4: 108 inches with 3/8-inch rod.
6. NPS 1-1/2: 10 feet with 3/8-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

3.6 IDENTIFICATION

A. Install identifying labels every 10 feet and at both sides of wall penetrations:

1. Breathing Air: Black letters on yellow background.

3.7 FIELD QUALITY CONTROL FOR MEDICAL COMPRESSED-AIR PIPING IN HEALTHCARE FACILITIES

A. Perform field tests and inspections.

B. Tests and Inspections:

1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill breathing air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 180 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
2. Repair leaks and retest until no leaks exist.
3. Inspect pressure regulators for proper operation.

C. Prepare test reports

D. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.8 PROTECTION

A. Protect tubing from damage.

B. Retain sealing plugs in tubing, fittings, and specialties until installation.

C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.9 PIPING SCHEDULE

A. Flanges may be used where connection to flanged equipment is required.

B. Breathing Air Piping: Type L, copper tube; wrought-copper fittings; and solder joints.

3.10 VALVE SCHEDULE

A. Shutoff Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.

END OF SECTION 115721

SECTION 115800 - FLUID LUBRICATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes fluid lubrication system equipment.

B. Related Sections include the following:

1. Division 11 Section "Fluid Lubrication Piping" for distribution piping.

1.3 REFERENCE

A. The publications listed below form a part of this specification to the extent referenced.

B. The publications are referenced in the text by basic designation only.

1. Underwriters Laboratories
2. NFPA 30/30A
3. Connecticut Fire Code

1.4 QUALITY ASSURANCE

A. American Society for Testing and Materials (ASTM)

1. A53-81a Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
2. A120-81 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses.

B. Underwriters Laboratories, Inc. (UL)

1. Requirements applicable to product listing and labeling.

C. All work shall be installed in compliance with NFPA Standards 17, 30, 30A, and 31.

D. Comply with Connecticut Department of Transportation and local state codes.

E. Comply with EPA Regulations 40 CFR Part 280.

F. Installing contractor shall be fully qualified for fluid tank installations by the tank manufacturer and shall have attended the manufacturer's training seminar within the past two years.

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. All components shall be fully tested and documented to operate as a complete system

I. Manufacturer's Representative: The manufacturer authorized representative shall be factory trained and certified personnel providing service, startup, and quality control field labor for the project from their local office
   1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out and start up.
   2. Training: Provide technical representative to train Owner's maintenance personnel in operation and maintenance of specified equipment

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. Product Data: For pipe, tube, fittings, pumps, tanks, monitoring systems, specialties, and couplings.

C. Shop drawings and schematics detailing fabrication, installation, piping layout, materials and finishes, system interconnections, and utility connections of equipment assemblies. Indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection

D. Wiring diagrams detailing power and control wiring and differentiating clearly between manufacturer-installed wiring and field-installed wiring

1.6 INFORMATION SUBMITTALS

A. Factory tests and inspection reports prior to shipping.

B. Field test and start-up reports, indicating and interpreting test results relative to compliance with specified requirements, for information.

C. Certificates: For certification required in "Quality Assurance" Article

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For the equipment identified to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide five extra pump mufflers.

2. Provide five extra inlet compressed air hose kits.

1.9 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, function and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.

D. All parts shall be readily available locally in the United States.

E. Any units or parts which prove defective during the warranty period will be replaced with OEM parts and transportation prepaid.

1.10 COORDINATION

A. Coordinate size and location of all foundations, supports, piping, electrical connections, and controls.

1.11 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid or dusty conditions.

B. Label all containers, including those contained in others, on outside with item description(s) per title and Mark Number of this specification.

C. Provide equipment and materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

1.12 LABELING

A. Nameplate: Manufacturer shall securely attach in a prominent location on each major item of equipment a non-corrosive nameplate with stamped figures showing manufacturer's name, address, model number, serial number and pertinent utility or operating data.

B. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (U.L.), or other National Recognized Testing Laboratory (NRTL), in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant.

PART 2 - PRODUCTS

2.1 GENERAL

A. Work Included: Provide materials and equipment necessary to install, test and make ready for operation a fluid dispensing system that is comprised of fluid reel banks, dispense consoles fluid dispensing pumps, and various components as specified here in,

B. Above Tanks and Drums, except waste storage, shall each be fully filled with designated fluid. Obtain owner approval for fluid manufacturer prior to installation.

C. Provide 10” x 14” signs (wall mounted) over each pump.

D. Provide labels at each hose reel designating fluid.

2.2 ABOVEGROUND FLUID STORAGE TANKS

A. Manufacturer
   1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Containment Solutions.

B. Comply with the following standards:
   1. UL 142- Underwriters Laboratories, Inc., Steel Aboveground Tanks for Flammable and Combustible Liquids.
   2. U.L. 2085, Underwriters Laboratories 2 Hour Fire Rating's Standard for Insulated.
   3. NFPA 30, National Fire Protection Association Flammable and Combustible Code.
   4. NFPA 30A, National Fire Protection Association Automotive and Marine Service Station
   5. Uniform Fire Code International Fire Code Institute
   6. B.O.C.A. National Fire Prevention Code

C. General Tank Description:
   1. Tanks are designed and UL listed as atmospheric tanks with a maximum working pressure of 1 PSI.
   2. The primary tank and the secondary containment tank shall have passed a proof of design hydrostatic pressure test of 25 PSI.
   3. Tanks shall be equipped with (9) total openings- four (4) NPT openings, plus one for primary tank working vent, one for primary tank emergency vent, one for monitoring the interstitial space, one for secondary tank emergency vent, and one for secondary tank emergency vent. The emergency vents shall be sized per NFPA & UL 142 requirements. Coordinate tank opening quantity and
   4. The tank shall be equipped with a minimum two (2) lifting lugs.
   5. Tanks include a 1 year warranty.
   6. Tank shall be provided with threaded PVC plugs in fittings (water tight).

7. The primary and secondary containment tank shall be pressure tested in the factory to UL 142 specification (3 PSI).
8. Tank is to be air tested at the factory but MUST be retested at the jobsite by the installer prior to installation and meet UL142 specifications

D. Primary Tank
1. The standard primary storage tank shall be rectangular in design. The tank will be constructed of UL 142 specified thickness, with continuous welds.
2. The primary storage tank shall be constructed of ASTM A-569 or A-36 carbon steel or 304 stainless steel, as required for compatibility of products being stored.

E. Secondary Containment Tank:
1. The secondary containment tank shall be rectangular in design and constructed of UL 142 specified steel thickness, with continuous welds.
2. The secondary containment tank shall be listed by Underwriters Laboratories as secondary containment under UL 142 standard.

F. Finish
1. The exterior surface of the secondary tank shall be cleansed of foreign material and coated with a corrosion resistant industrial paint (3 to 5 mils dry film thickness)
2. The standard color shall be desert sand.

2.3 ABOVEGROUND STEEL CLOSED HEAD STORAGE DRUM

A. Materials

1. Only new material shall be used in the manufacturing process and the manufacturer shall ensure that the material used meets all appropriate specifications and quality assurance requirements.
2. Material Requirements
   a. Nominal capacity of the tank(s) shall be: See drawings
   b. Minimal material thickness of the tank(s) shall be 18 gauge steel.
   c. Provide polyethylene tanks for storing windshield washer fluid and engine coolant.
3. Loading Conditions: Tank shall meet the following design criteria.
   a. Internal Load: Tank(s) shall withstand an air pressure test of 1.5-2.5 psi.
4. Product Storage Requirements
   a. Tank(s) shall be capable of storing liquids with a specific gravity up to 1.1.
   b. Tank(s) is designed for operation at atmospheric pressure only. Tank(s) shall have openings of sufficient size to meet normal venting requirements as stated in U.L. 142, UFC, and NFPA 30.
   c. Tank(s) shall be capable of storing motor oil, gear oil, windshield washer fluid, grease, engine coolant, and automatic transmission fluid at ambient temperature.

B. Accessories

1. Certification Plate: Underwriters Laboratories label shall be affixed to each tank.
2. Fittings: Threaded/NPT

a. All threaded fittings shall be of a material of construction consistent with the requirements of the Underwriters Laboratories label. All fittings shall be protected using threaded plugs or suitable closure caps.
b. Location: Refer to drawings.
c. Primary vent to be 3/4” vent with Sch 40 galvanized nipple
d. 2” bung hole for connection to pump suction kit

C. Installation

1. Tank shall be installed in strict accordance with the most recent installation instructions provided by the tank manufacturer, PEI/RP200, UFC, NFPA 30, local ordinance, recognized engineering procedure, and other applicable codes.

D. Factory Painting

1. Prepare tank surface with SSPC-SP-3 sandblast. Finish tank suface with factory applied epoxy finish.

2.4 MANUFACTURER

A. Manufacturer
1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Graco Inc

2.5 USED OIL AND COLLANT EVACUATION SYSTEMS

A. The system to be a wall mount 1” double diaphragm pump. The diaphragm pump to be of aluminum construction and have TPE diaphragms, balls & seats. Pump to include the following components:
1. Air and fluid connecting hose kit
2. Air filter/regulator/lubricator kit with gauge and automatic tank drain valve on the air filter
3. Air guard runaway valve for pump protection
4. Wall bracket
5. Adapters
6. 2000 PSI Stainless steel ball type fluid shut-off valve for pump outlet
7. 10 FT evacuation hose kit
8. Air solenoid valve
a. Power open, spring closed
b. 24 V DC
c. Leads: 18 AWG x 12 in

B. Supply the following portable used oil receivers:

1. 25 gallon, portable used oil receiver with top connect coupler. Refer to specification 115100 “Shop Equipment” for further requirements.

C. Provide high level alarm/ pump shut-off system for used oil and used coolant. Refer to overfill alarm and acknowledgement specifications below. Locate alarm on wall near fluid evacuation

systems and install above floor per the local electrical code. Overfill alarm to be controlled by web based inventory and leak detection control panel.

2.6 WINDSHIELD WASHER FLUID (WWF) PUMP FOR 55 GALLON DRUM WALL MOUNT INSTALLATION

A. The system to be a wall mount 1” double diaphragm pump. The diaphragm pump to be of aluminum construction and have TPE diaphragms, balls & seats. The unit to be complete with all necessary components to draw washer fluid from a 55 gallon drum. The pump to have a 1½” NPT (F)aluminum drop tube. Pump to include the following components:

1. Pressure relief kit
2. Air and fluid connecting hose kit
3. Air filter/regulator/lubricator kit with gauge and automatic tank drain valve on the air filter
4. Air guard runaway valve for pump protection
5. Wall bracket
6. Adapters
7. Suction hose kit with low level cut off
8. 2000 PSI Stainless steel ball type fluid shut-off valve for pump outlet.

2.7 ENGINE COOLANT PUMP FOR 55 GALLON DRUM WALL MOUNT INSTALLATION

A. The system to be a wall mount 1” double diaphragm pump. The diaphragm pump to be of aluminum construction and have TPE diaphragms, balls & seats. The unit to be complete with all necessary components to draw engine coolant from a 55 gallon drum. The pump to have a 1½” NPT (F)aluminum drop tube. Pump to include the following components:

1. Pressure relief kit
2. Air and fluid connecting hose kit
3. Air filter/regulator/lubricator kit with gauge and automatic tank drain valve on the air filter
4. Air guard runaway valve for pump protection
5. Wall bracket
6. Adapters
7. Suction hose kit with low level cut off
8. 2000 PSI Stainless steel fluid ball type shut-off valve for pump outlet

2.8 ENGINE COOLANT (EC) PUMP FOR TANK MOUNT INSTALLATION

A. The positive displacement piston oil pump shall have a pneumatically operated Monarch series 3” diameter air motor, a 3” pumping stroke length and cycle on demand only. The air motor is to have an internal muffler that operates below OSHA noise standards, and be equipped with a grounding lug. The design of the air motor shall incorporate a valve in piston design which increases the pump's durability, longevity and gives uniform delivery on both the up and down strokes. The air motor cylinder material is to be hard coated aluminum and corrosive resistant steel. The air motor to feature a non-metallic poppet valve. The air motor and lower pump section shall be of the divorced design and have stainless steel lower unit components. The pump to have a stainless steel down tube with a 1½” NPT (F) fluid inlet. Pump to include the following components:

1. Pressure relief kit
2. Air and fluid connecting hose kit
3. Air filter/regulator/lubricator kit with gauge and automatic tank drain valve on the air filter
4. Air guard runaway valve for pump protection
5. 2,000 psi ball type shut-off valve for pump outlet

2.9 GEAR OIL (GO) PUMP FOR 55 GALLON DRUM WALL MOUNT INSTALLATION

A. The positive displacement oil pump shall have a pneumatically operated 4 ¼" diameter air motor, a 4 ¼" pumping stroke length and cycle on demand only. The air motor is to have an external muffler that operates below OSHA noise standards, and be equipped with a grounding lug. The design of the air motor shall incorporate a valve in piston design which increases the pump's durability, longevity and gives uniform delivery on both the up and down strokes. The air motor cylinder material is to be hard coated aluminum and corrosive resistant steel. The air motor to feature a non-metallic poppet valve. The air motor and lower pump section shall be of the divorced design. The pump to have a 1½" NPT (F)aluminum drop tube. Pump to include the following components:
1. Pressure relief kit
2. Air and fluid connecting hose kit
3. Air filter/regulator/lubricator kit with gauge and automatic tank drain valve on the air filter
4. Air guard runaway valve for pump protection
5. Wall bracket
6. Adapters
7. Suction hose kit with low level cut off
8. 2,000 psi ball type shut-off valve for pump outlet

2.10 AUTOMATIC TRANSMISSION FLUID (ATF) PUMP FOR 55 GALLON DRUM WALL MOUNT INSTALLATION

A. The positive displacement oil pump shall have a pneumatically operated 3" diameter air motor, a 3" pumping stroke length and cycle on demand only. The air motor is to have an external muffler that operates below OSHA noise standards, and be equipped with a grounding lug. The design of the air motor shall incorporate a valve in piston design which increases the pump's durability, longevity and gives uniform delivery on both the up and down strokes. The air motor cylinder material is to be hard coated aluminum and corrosive resistant steel. The air motor to feature a non-metallic poppet valve. The air motor and lower pump section shall be of the divorced design. The pump to have a 1½" NPT (F)aluminum drop tube. Pump to include the following components:
1. Pressure relief kit
2. Air and fluid connecting hose kit
3. Air filter/regulator/lubricator kit with gauge and automatic tank drain valve on the air filter
4. Air guard runaway valve for pump protection
5. Wall bracket
6. Adapters
7. Suction hose kit with low level cut off
8. 2,000 psi ball type shut-off valve for pump outlet

2.11 AUTOMATIC TRANSMISSION FLUID (ATF) PUMP FOR TANK MOUNT INSTALLATION

A. The positive displacement oil pump shall have a pneumatically operated 4 ¼" diameter air motor, a 4 ¼" pumping stroke length and cycle on demand only. The air motor is to have an external muffler that operates below OSHA noise standards, and be equipped with a grounding lug. The design of the air motor shall incorporate a valve in piston design which increases the pump's durability, longevity and gives uniform delivery on both the up and down strokes. The air motor cylinder material is to be hard coated aluminum and corrosive resistant steel. The air motor to feature a non-metallic poppet valve. The air motor and lower pump section shall be of the divorced design. The pump to have a 1½" NPT (F) stainless steel drop tube. Pump to include the following components:

1. Pressure relief kit
2. Air and fluid connecting hose kit
3. Air filter/regulator/lubricator kit with gauge and automatic tank drain valve on the air filter
4. Air guard runaway valve for pump protection
5. 2,000 psi ball type shut-off valve for pump outlet

2.12 ENGINE OIL (EO) PUMP FOR TANK MOUNT INSTALLATION

A. The positive displacement oil pump shall have a pneumatically operated 4 ¼" diameter air motor, a 4 ¼" pumping stroke length and cycle on demand only. The air motor is to have an external muffler that operates below OSHA noise standards, and be equipped with a grounding lug. The design of the air motor shall incorporate a valve in piston design which increases the pump's durability, longevity and gives uniform delivery on both the up and down strokes. The air motor cylinder material is to be hard coated aluminum and corrosive resistant steel. The air motor to feature a non-metallic poppet valve. The air motor and lower pump section shall be of the divorced design. The pump to have a 1½" NPT (F) stainless steel drop tube. Pump to include the following components:

1. Pressure relief kit
2. Air and fluid connecting hose kit
3. Air filter/regulator/lubricator kit with gauge and automatic tank drain valve on the air filter
4. Air guard runaway valve for pump protection
5. 2,000 psi ball type shut-off valve for pump outlet

2.13 CHASSIS GREASE (CG) 400 LB DRUM PUMP SYSTEM:

A. The positive displacement oil pump shall have a pneumatically operated 4 1/4" diameter air motor, a 4" pumping stroke length and cycle on demand only. The air motor is to have an integral muffler that operates below OSHA noise standards, and be equipped with a grounding lug. The design of the air motor shall incorporate a valve in piston design which increases the pump's durability, longevity and gives uniform delivery on both the up and down strokes. The air motor cylinder material is to be hard coated aluminum and corrosive resistant steel. The pump system to include pump elevator, inductor plate, carriage, and connecting hoses.

1. Air and fluid connecting hose kit

2. Air filter/regulator/lubricator kit with gauge and automatic tank drain valve on the air filter
3. Air guard runaway valve for pump protection
4. Provide stationary supply stand
5. 5,000 psi needle shut-off valve for pump outlet

2.14 DIESEL EXHAUST FLUID (DEF) PUMP

A. The system to be a wall mount, double diaphragm pump. The diaphragm pump to be of polypropylene construction and have PTFE ball, flouroelastomer seat and stainless steel diaphragm materials. The unit to be complete with all necessary components to draw DEF from storage tank. The pump to have a 1½" NPT (F) stainless steel drop tube. Pump to include the following components:
   1. Pressure relief kit
   2. Air and fluid connecting hose kit
   3. Air filter/regulator/lubricator kit with gauge and automatic tank drain valve on the air filter
   4. Air guard runaway valve for pump protection
   5. Wall bracket
   6. Adapters
   7. Suction hose kit with low level cut off
   8. 2000 PSI ball type stainless steel fluid shut-off valve for pump outlet

2.15 FLUID DISPENSING REELS

A. General:
   1. Provide steel reel mounting channels to mount the number of reels as per each overhead reel station. The channel to accept specified reels. Channel to be painted black.

B. Reel Specification (EO, GO, ATF, EC, CG, CA, WWF):

   1. The hose reel shall have a minimum capacity of 50 feet of 1/2" ID hose for, EO, GO, ATF, EC, CG, and CA. The hose reel shall have a minimum capacity of 65 feet of 3/8" ID hose for WWF. The hose reel base will be a 10 gauge, heavy-duty double pedestal frame with welded joints and formed ribs for strength and durability.
   2. The ratchet assembly will be constructed of ZA-12 non-sparking alloy for use in fueling and other type environments. The ratchet will be designed to prevent damage in the event of being spun backwards and fits to an over-sized, two-point, mounted pivot support, that is removable as an assembly for service.
   3. The spring is a sealed unit and must be adjustable from the reel exterior with or without pressure and without removing the hose. The rewind motor spring will provide uniform tension through the usable range. It has high demand steel spring and external tension adjustment. The latch spring engineered to eliminate reel lock out condition.
   4. The reel spool to be all metal and have sealed roller bearings
   5. The fluid swivel will be full-ported, 1/2" NPT, with Viton seals and Teflon back up washers. The swivel will be completely accessible and serviceable without disassembly of other reel components. The swivel will be rated for a minimum of 1500-psi (103 bar) working pressure, and vacuum up to 24" Hg. (610mm Hg).

6. The hose guide roller assembly will be the full width of the spool, with 1-1/8” (29mm) diameter steel rollers, a one-piece roller support and Delrin bearings and seals.
7. The reel to be designed to mount on ceilings, wall or floors.
8. The bar stop assemblies will be constructed of high impact, molded Hytrel.
9. Accessories
    a. EO, ATF, GO- 2,000 psi ball type shut-off valve for reel inlet
    b. WWF & EC- 2,000 psi ball type stainless steel fluid shut-off valve for reel inlet
    c. CG- 5,000 psi needle shut-off valve for reel inlet

C. Reel Specification (DEF):

1. The hose reel shall have a minimum capacity of 50 feet of 3/4” ID, DEF compatible hose. The hose reel base will be a 10 gauge, heavy-duty double pedestal frame with welded joints and formed ribs for strength and durability.
2. The ratchet assembly will be constructed of ZA-12 non-sparking alloy for use in fueling and other type environments. The ratchet will be designed to prevent damage in the event of being spun backwards and fits to an over-sized, two-point, mounted pivot support that is removable as an assembly for service.
3. The two, (one on each side) sealed, self-aligning ball bearings, support the hose spool on the reel base. The spool will be a welded assembly with formed flange support ribs and rolled edges for strength and durability. The rewind motor spring will provide uniform tension through the usable range. It has high demand steel spring and external tension adjustment. The latch spring engineered to eliminate reel lock out condition.
4. Provide with double-riveted connections and contained in its own lubricated, sealed safety canister. The canister assembly will be mounted externally to the reel base and have an external spring tension adjustment
5. The fluid swivel will be full-ported, 3/4” BSPP thread, with stainless steel seals and back up washers. The swivel will be completely accessible and serviceable without disassembly of other reel components. The swivel will be rated for a maximum of 50 psi working pressure.
6. The hose guide roller assembly will be the full width of the spool, with 1-1/8” (29mm) diameter steel rollers, a one-piece roller support and Delrin bearings and seals.
7. The reel to be designed to mount on ceilings, wall or floors.
8. The bar stop assemblies will be constructed of high impact, molded Hytrel.
9. Accessories:
    a. 3/4” 2,000 psi stainless steel ball type shut-off valve

D. Reel Specifications (Elec)
1. The hose reel shall have a minimum capacity of 95 feet of 12 gauge insulated electrical cord. The hose reel base will be a 10 gauge, heavy-duty single pedestal frame with welded joints and formed ribs for strength and durability.
2. The ratchet assembly will be constructed of ZA-12 non-sparking alloy for use in fueling and other type environments. The ratchet will be designed to prevent damage in the event of being spun backwards and fits to an over-sized, two-point, mounted pivot support, that is removable as an assembly for service
3. Provide with single industrial receptacle.
4. Reel to be provided with an adjustable arm
5. The spring is a sealed unit and must be adjustable from the reel exterior with or without pressure and without removing the hose. The rewind motor spring will provide uniform tension through the usable range. It has high demand steel spring and external tension adjustment. The latch spring engineered to eliminate reel lock out condition

6. The reel to be designed to mount on ceilings, wall or floors.
7. Electrical:
   a. 120V/1
   b. 18 amp

2.16 DISPENSING HANDLES

A. General
1. The dispensing handles to be designed and manufactured by same manufacturer of the fluid pumps and reels.
2. The compressed air reel to be provided with air coupler to match the ones to be utilized by owner.
3. Provide for each reel hose an identification label that has the product ID and snaps around the hose at the bottom near dispense valve connection.
4. Label to be plastic, available in 9 standard colors and have clearly visible lettering.
5. Reference: Seton, custom Setmark snap around pipe markers.

B. Dispensing handles specifications (EO, EC, ATF, GO)
1. The handle is to be heavy duty cast construction with trigger guard, trigger lock and inlet swivel.
2. The meter to have large LCD display with set up menu to program display resolution/lighting, calibration and units of measurement. There are to be simple control buttons on the meter head for ease of operation.
3. The meter head to have protective high density housing and the inlet swivel to have protection boot.
4. The meter has the ability to be pre-set for desired units and has an automatic shut-off.
5. The max flow to be 5 GPM.
6. The meter head to have protective housing and inlet swivel protection boot.
7. The unit to operate on replaceable AA alkaline battery.
8. Nozzle end:
   a. EO- rigid extension with standard automatic non-drip quick-close nozzle for oil.
   b. EC- rigid extension with standard quick close nozzle for engine coolant
   c. ATF- flexible extension with standard automatic non-drip quick-close nozzle for oil.
   d. GO- extension with standard quick-close nozzle for gear oil.

C. Dispensing handles specifications (WWF)
1. The dispense valve to be a bib type valve with rubber tip.
2. Valve to have bottom trigger and ¼” NPT inlet with screen.
3. Full volume dispense nozzle.

D. Dispensing handles specifications (CG)
1. The dispense valve to be of machined steel construction.
2. The valve to have rugged heavy duty handle with trigger guard.
3. The trigger to have a top adjustment nut, lockable.
4. The valve to be able to dispense grease up to NLGI #2.
5. The valve to include Z-swivel and 30” whip hose with coupler

E. Dispensing handles specifications (DEF)
   1. The handle is to be heavy duty cast construction with trigger guard, trigger lock and stainless steel inlet swivel.
   2. Provide stainless steel nozzle.
   3. The meter head to have protective high density housing and the inlet swivel to have protection boot.

2.17 MANAGEMENT/MONITORING SYSTEM

A. Manufacturer
   1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Veeder Root

B. Tank level probes: Magnetostrictive Inventory only probe
   1. Stainless steel guide tube
   2. Temperature rating: -40 deg F to 140 deg F
   3. Adjustable spacers
   4. Length to be verified prior to ordering
   5. Provide installation kit
   6. Provide float kit, to be verified prior to ordering.
   7. Provide with water detection for all fluids except waste oil and waste coolant inventory probes. Waste oil and waste coolant inventory probes to be provided without water detection.

C. Interstitial sensors for steel tanks: detects the presence of liquid in the interstitial space of a double walled steel tank. When liquid is detected the sensor sends an alarm signal to the monitor.
   1. Cable length: to be verified prior to ordering
   2. Temperature rating: -20 deg C to 70 deg C
   3. Provide with watertight cord grips
   4. Two wires are required to connect to the monitor

D. Overfill alarms and acknowledgement: Wired to an alarm relay in the monitor, the alarm relay activates the overfill alarm horn and light when a potential overfill is detected. Limits can be set at each tank location.
   1. Alarm horn: adjustable noise level from 78 to 103 dB (at 10 feet)
   2. Alarm light: 25 watt, red polycarbonate lens, 75 per minute flashing rate
   3. Alarm acknowledgement switch: when the acknowledgement button is pressed the overfill alarm shuts off and the alarm acknowledgement light illuminated. 120 volt amber lens.
   4. Enclosure: Painted steel, NEMA 4. ½” conduit connector at the bottom
   5. Supply voltage: 120VAC

E. Inventory and leak detection monitor panel: Web based internet browser with Ethernet connection
   1. Up to three years of data history
   2. Inventory and delivery monitoring and reporting
   3. Support up to 32 probes
   4. Interstitial/sump monitoring
   5. Dispenser sump monitoring

6. Groundwater monitoring
7. Email notification and reporting
8. Vapor well monitoring
9. Continuous statistical leak detection software built programmed into controller.
10. 3.0 gph, .1 gph, and .2 gph in tank leak detection
11. 3.0 gph, .1 gph, and .2 gph in line leak detection
12. Sensor status report
13. Sensor status history report
14. 7.4” full VGA LCD tough screen display
15. High resolution, high speed printer
16. Universal compartments support universal sensor and probe module and output interface module
17. Built-in relay for overfill alarm
18. Supports multiple languages
19. Intuitive and user friendly interface
20. Single tough screen access to most functions
21. Customizable on-board help
22. Custom dashboard
23. Remote web access
24. XML web-enabled interface
25. Up to nine communication ports
26. Internal auto-dial fax modem communication
27. RS-232 and RS-485 data communication
28. USB ports for software upgrades and data backup.
29. Electrical: 120 VAC
30. Provide panel with relay to de-energize used oil and used coolant solenoid valve upon high level detection.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Installation of all equipment and systems and components shall be by experienced installers capable of installing each item in accordance with drawings and specifications and manufacturers requirements.

B. Set work accurately, in alignment and where shown. Items shall be plumb, level, free of rack and twist, and set parallel or perpendicular as required to line and plane of surface.

C. Install equipment with clearances for service and maintenance.

D. Support suspended hose reels from structure.

1. Install as per manufacturer’s instructions.

3.2 CLEANING AND ADJUSTING

A. After installation all items shall be cleaned as recommended by the manufacturer and protected from damage until completion of the project. All movable parts shall be cleaned and adjusted to operate as designed without binding or deformation of the members and where applicable, to have all contact surfaces fit tight and even without forcing or warping the components.

3.3 FIELD QUALITY CONTROL AND TESTING

A. Manufacturer's Field Service: Engage a factory-authorized service representative to start-up inspect, test, and adjust components, assemblies, and equipment installations, including connections, check operation of the equipment and components for operation and performance as specified and examine the finish for damage. Provide report in writing that the installation meets the requirements and shall include information concerning minor adjustments and minor repairs, which may be required before final acceptance by the Owner.

B. General:

1. Installer must test in demonstrate the integrity of tanks, piping, and secondary containment as well as the satisfactory operation of gauging an monitoring systems, before the storage tank system is placed into service. Additionally, the installer is responsible for inspecting and testing the overfill-prevention equipment, line leak detectors and all valves installed to control product flow to verify the safety of the system.

2. Test all system components, piping, tanks, dispensers, etc for complete and correct system operation and demonstrate to owner prior to the system being placed in operation.
3. All testing shall be in compliance with NFPA 30 and 30a requirements

C. Tank:

1. Tanks are to be factory tested prior to shipment and field tested prior to system start-up.
2. Air pressure test both the primary and secondary tank in accordance with the tank manufacturer’s recommendations. In addition to the pressure test, cover the entire tank surface, manways and all fittings with soap solution and inspect for leaks.
3. There shall be no drop in pressure.
4. Fill containment sump/turbine enclosure with water. There shall be no drop in the alter level after four hours.
5. Tank to be tested with air pressure not less than a gauge pressure of 3 psi and not more than a gauge pressure of 5 psi for two hours.
6. The interstitial space shall be air tested at a gauge pressure of 3 psi to 5 psi, by vacuum, or in accordance with the tank’s listing of the manufacturer’s instructions

D. Upon completion of the installation the Installer shall conduct operating test for approval of the Owner. These tests shall include but not be limited to the following:

1. All tests per manufacturer instructions.
2. Demonstration & training of all equipment to owner’s personnel.

E. Tests shall be performed as outlined in the reference cited herein.

F. All test equipment and facilities shall be furnished at no additional expense to the Owner.

G. Final acceptance
   1. All tanks to be completely filled with product for acceptance by the state

3.4 DEMONSTRATION

1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fluid lubrication system equipment.
2. Review data in maintenance manuals.
3. Schedule training with Owner and Architect with at least 14 days advance notice. Owner’s personnel training shall be for not less than 4 hours.
4. Provide training for up to ten (10) people.

END OF SECTION 115800

SECTION 115810- FLUID LUBRICATION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes fluid lubrication piping, specialties, and accessories within the building.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working-Pressure Rating: Unless otherwise indicated, minimum pressure requirement for piping is 150 psig.

1.4 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.

D. All components shall be fully tested and documented to operate as a complete system

E. Manufacturer's Representative: The manufacturer authorized representative shall be factory trained and certified personnel providing service, startup, and quality control field labor for the project from their local office

1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out and start up.

F. Training: Provide technical representative to train Owner's maintenance personnel in operation and maintenance of specified equipment

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

H. Comply with NFPA 30, "Flammable and Combustible Liquids Code," and NFPA 30a

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. Product Data: For each type of the following:
   1. Piping
   2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

C. Provide piping schedule indicating type of intended installation and installation location. Refer to piping schedule below.

D. Shop/Coordination Drawings: Produced in electronic format (compatible with Autocad 2008) Detailed at ¼" =1'-0" scale, double lined. Drawings shall indicate duct and pipe layout and elevation, and all equipment with manufacturers' recommended maintenance access. The following items shall be shown and coordinated with each other, using input from installers of the items and trades involved: (Submit 3 hard copies of all documents to Architect for Review and Approval):

   1. Duct and piping installation in all spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct and piping layout.
   2. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   3. Fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides.
   4. Detail location of anchors, alignment guides, and expansion joints and loops.

   5. Piping layout indicating sizes, configuration, and service.
   6. Elevation of top of ducts and pipes.
   7. Dimensions of main duct runs from building grid lines.
   8. Duct and pipe fittings.
   9. Reinforcement and spacing.
   10. Suspended ceiling components.
   11. Structural members to which duct and piping will be attached.
   12. Room walk paths and equipment access
   13. Items penetrating finished ceiling including the following:

      a. Lighting fixtures.
      b. Air outlets and inlets.

1.6 INFORMATION SUBMITTALS

A. Certificates: For certification required in "Quality Assurance" Article.

B. Welding certificates.

C. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For the equipment identified to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, and fitting materials.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Wrought-Copper Fittings: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article

C. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

D. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

E. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed

2.4 STAINLESS STEEL PIPING

A. Stainless-Steel Pipe: ASTM A 312/A 312M, Schedule 40.

B. Stainless-Steel Pipe Fittings: ASTM A 182

2.5 JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Nipples:

1. Performance: Subject to compliance with requirements and related documents, provide products meeting a minimum performance of the following:
2. Description:

   a. Standard: IAPMO PS 66
   b. Electroplated steel nipple. complying with ASTM F 1545.
   c. Pressure Rating: 2000 psig at 225 deg F.
   d. End Connections: Male threaded or grooved.
   e. Lining: Inert and noncorrosive, propylene

2.7 VALVES

A. Refer to fluid lubrication system specifications and drawings for valve type and location.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. General: Unions, transition, and special fittings with pressure ratings same as or higher than system pressure rating may be used in applications below, unless otherwise indicated.

B. Fluid Piping System

1. The contractor to provide the following required steel pipe and/or copper tubing to make up fluid lubrication system and connection to dispense reels. The contractor to furnish and install all required hangers, brackets, fittings, hardware to attach piping. The fluid lubrication system to be tested per manufacturer's standards.

Fluid/Service	Type
Engine Oil (EO)	Sch 40 Steel Pipe, Grade B, ERW
Windshield Washer Fluid (WWF)	Copper Pipe
Automatic Transmission Fluid (ATF)	Sch 40 Steel Pipe, Grade B, ERW
Engine Coolant (EC)	Copper Pipe
Gear Oil (GO)	Sch 40 Steel Pipe, Grade B, ERW
Chassis Grease (CG)	Sch 160 Steel Pipe, Grade B, seamless
Diesel Exhaust Fluid (DEF)	Sch 40 Stainless Steel Pipe, type 304
Used Oil	Sch 40 Steel Pipe
Used Coolant	Copper Pipe

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

C. Install piping to permit valve servicing.

D. Install piping at indicated slopes.

E. Install piping free of sags and bends.

F. Install fittings for changes in direction and branch connections.

G. Select system components with pressure rating equal to or greater than system operating pressure.

H. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

I. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

J. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

K. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

L. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

M. Install unions in piping**,** NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

N. Install shutoff valve immediately upstream of each dielectric fitting.

3.3 JOINT CONSTRUCTION

A. Copper- Wrought copper fittings and soldered joints

B. Steel Pipe-
   1. EO, ATF, and used oil- threaded malleable iron 300 psi fittings and threaded joints
   2. Grease- Forged steel9000 psi socket weld fittings and welded joints
   3. GO- Forged steel 3000 psi socket weld fittings and welded joints

C. Stainless Steel Pipe-
   1. DEF- Class 150 Stainless wrought socket weld fittings

3.4 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.

3.5 VALVE INSTALLATION

A. Install valves in accessible locations, protected from possible damage.

B. Install valves at pump outlet and at inlet to hose reel.

3.6 HANGER AND SUPPORT INSTALLATION

A. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

   1. NPS 1/2 and Smaller: Maximum span, 60 inches; minimum rod size, 3/8 inch.
   2. NPS 3/4 to NPS 1-1/4: Maximum span, 84 inches; minimum rod size, 3/8 inch.
   3. NPS 1-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.

B. Support vertical steel pipe at each floor and at spacing not greater than 10 feet.

C. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.

2. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe

3.7 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

D. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

3.8 PAINTING

A. Paint metal piping, valves and piping specialties, except components, with paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.

   a. Prime Coat: Quick-drying alkyd metal primer.
   b. Intermediate Coat: Interior latex matching topcoat.
   c. Topcoat: Interior latex (semigloss).

2. Color:
   a. Engine oil- Blue
   b. Automatic Transmission Fluid- Orange
   c. Gear oil- Lt Blue
   d. Common grease- Green

B. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish

3.9 LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high

D. Pipe label color schedule
1. All labels
a. Background color: Black
b. Letter color: White

3.10 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to start-up inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. General:

1. Installer must test in demonstrate the integrity of tanks, piping, and secondary containment as well as the satisfactory operation of gauging an monitoring systems, before the storage tank system is placed into service.

2. Test all system components and piping for complete and correct system operation and demonstrate to owner prior to the system being placed in operation.
3. All testing shall be in compliance with NFPA 30 and 30a requirements

C. Piping:

1. Test aboveground piping at 150% of operating pressure but no less than 100 psig air pressure for two hours. Soap all joints.
2. There shall be no drop in pressure

D. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.

E. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. Report test results promptly and in writing to Architect.

END OF SECTION 115810

SECTION 122113 - HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Horizontal louver blinds with aluminum slats.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

C. Shop Drawings: Show fabrication and installation details for horizontal louver blinds.

D. Samples: For each exposed product and for each color and texture specified, 12 inches (300 mm) long.

E. Samples for Initial Selection: For each type and color of horizontal louver blind.

1. Include similar Samples of accessories involving color selection.

F. Samples for Verification: For each type and color of horizontal louver blind indicated.

1. Slat: Not less than 12 inches (300 mm) long.
2. Tapes: Full width, not less than 6 inches (150 mm) long.
3. Horizontal Louver Blind: Full-size unit, not less than 16 inches (400 mm) wide by 24 inches (600 mm) long.
4. Valance: Full-size unit, not less than 12 inches (300 mm) wide.

G. Window-Treatment Schedule: For horizontal louver blinds. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Horizontal Louver Blinds to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials**,** from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Horizontal Louver Blinds: Full-size units equal to 5 percent of quantity installed for each size, color, texture, pattern, and gloss indicated, but no fewer than two.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver horizontal louver blinds in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain horizontal louver blinds from single source from single manufacturer.

2.2 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS

A. Basis-of-Design Product: Subject to compliance with requirements, provide CE80; Hunter Douglas Contract.

B. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile and radius corners.

1. Width: 1 inch (25 mm)
2. Thickness: Not less than 0.008 inch (0.20 mm).
3. Spacing: 20mm..
4. Finish: Ionized antistatic, dust-repellent, baked polyester finish..
5. Features:

a. Lift-Cord Rout Holes: Minimum size required for lift cord and located near back (outside) edge of slat to maximize slat overlap and minimize light gaps between slats.

C. Headrail: Formed steel or extruded aluminum; long edges returned or rolled. Headrails fully enclose operating mechanisms on three sides.

1. Capacity: One blind per headrail unless otherwise indicated.
2. Ends: Capped or plugged.
3. Manual Lift Mechanism:

a. Lift-Cord Lock: Variable; stops lift cord at user-selected position within blind full operating range.
b. Operator: Extension of lift cord(s) through lift-cord lock mechanism to form cord pull.

4. Manual Tilt Mechanism: Enclosed worm-gear mechanism and linkage rod that adjusts ladders.

a. Tilt: Full.
b. Operator: Clear-plastic wand.
c. Over-Rotation Protection: Manufacturer's detachable operator or slip clutch to prevent over rotation of gear.

5. Manual Lift-Operator and Tilt-Operator Lengths: Full length of blind when blind is fully closed.
6. Manual Lift-Operator and Tilt-Operator Locations: Right side of headrail unless otherwise indicated.

D. Bottom Rail: Formed-steel or extruded-aluminum tube that secures and protects ends of ladders and lift cords and has plastic- or metal-capped ends.

1. Type: Top contoured to match crowned shape of slat.

E. Lift Cords: Manufacturer's standard braided cord.

F. Ladders: Evenly spaced across headrail at spacing that prevents long-term slat sag.

1. Type: Braided cord.

G. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.

1. Type: Overhead .
2. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.

H. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard.

I. Colors, Textures, Patterns, and Gloss:

1. Slats: As selected by Architect from manufacturer's full range.
2. Components: Provide rails, cords, ladders, and materials exposed to view matching or coordinating with slat color unless otherwise indicated.

2.3 HORIZONTAL LOUVER BLIND FABRICATION

A. Product Safety Standard: Fabricate horizontal louver blinds to comply with WCMA A 100.1 including requirements for corded, flexible, looped devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):

1. Outside of Jamb Installation: Width and length as indicated, with terminations between blinds of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.

1. Lift-and-Tilt Mechanisms: With permanently lubricated moving parts.

D. Mounting and Intermediate Brackets: Designed for removal and reinstallation of blind without damaging blind and adjacent surfaces, for supporting blind components, and for bracket positions and blind placement indicated.

E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to brackets and adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories under conditions of normal use.

F. Color-Coated Finish:

1. Metal: For components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install horizontal louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.

1. Locate so exterior slat edges are not closer than 1 inch (25 mm) from interior faces of glass and not closer than 1/2 inch (13 mm) from interior faces of glazing frames through full operating ranges of blinds.
2. Install mounting and intermediate brackets to prevent deflection of headrails.
3. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.

3.3 ADJUSTING

A. Adjust horizontal louver blinds to operate free of binding or malfunction through full operating ranges.

3.4 CLEANING AND PROTECTION

A. Clean horizontal louver blind surfaces after installation according to manufacturer's written instructions.

B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer and that ensures that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.

C. Replace damaged horizontal louver blinds that cannot be repaired in a manner approved by Architect before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems.

END OF SECTION 122113

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Motor-operated roller shades with single rollers.

B. Related Requirements:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
3. Section 079200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

C. Shop Drawings: Show fabrication and installation details for roller shades, including fabric materials, their orientation to rollers, and their seam and batten locations.

1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

D. Samples: For each exposed product and for each color and texture specified, 10 inches (250 mm) long.

E. Samples for Initial Selection: For each type and color of fabric material.

1. Include Samples of accessories involving color selection.

F. Samples for Verification: For each type of roller shade.

1. Fabric Material: Not less than 10 inches (250 mm) square. Mark inside face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches (400 mm) wide by 36 inches (900 mm) long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches (250 mm) long.

G. Roller-Shade Schedule: Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of fabric material, signed by product manufacturer.

C. Product Test Reports: For each type of fabric material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Roller Window Shades to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and fabric material indicated, but no fewer than two units.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Motor Mounted in Shade Pocket:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Radiance Motorized Shade; Insolroll.

B. Fabric Material:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Silverscreen; Verosol.

C. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MOTOR-OPERATED, SINGLE-ROLLER SHADES

A. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Electric Motor: Manufacturer's standard quiet operation tubular, enclosed in roller.

    a. Electrical Characteristics: Single phase, 110V, 60 Hz.

3. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following for remote-control activation of shades:

    a. Individual/Group Control Station: Maintained-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for individual and group control.
    b. Color: As selected by Architect from manufacturer's full range.

4. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.
5. Operating Features:

    a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of fabric panels indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of inside face of shade.
2. Direction of Shadeband Roll: Regular, from back of roller.
3. Fabric-to-Roller Attachment: Manufacturer's standard method, as recommended by the manufacturer..

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Fabric:

1. Fabric Panel Material: Light-filtering fabric.
2. Fabric Panel Bottom (Hem) Bar: Steel or extruded aluminum.

    a. Type: Enclosed in sealed pocket of shadeband material.
    b. Color and Finish: As selected by Architect from manufacturer's full range.

E. Installation Accessories:

1. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.

    a. Height: Manufacturer's standard in height required to enclose roller and shadeband when shade is fully open, but not less than 4 inches (102 mm).

2. Endcap Covers: To cover exposed endcaps.

3. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.

4. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 FABRIC PANEL MATERIALS

A. Fabric Panel Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: Verosol..
2. Composition: One layer of aluminum vacuum formed to PVC-coated fiberglass fabric.
3. Weave: Mesh.
4. Thickness: 0.50mm.
5. Weight: 400 g/sq. m.
6. Roll Width: Varies.
7. Openness Factor: 5 percent.
8. Color: As selected by Architect from manufacturer's full range.

2.4 ROLLER-SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):

1. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Fabric Panel Fabrication: Fabricate fabric panels without battens or seams to extent possible except as follows:

1. Vertical Shades: Where width-to-length ratio of fabric panel is equal to or greater than 1:4, provide battens and seams at uniform spacings along fabric panel length to ensure fabric panel tracking and alignment through its full range of movement without distortion of the material.
2. Railroaded Materials: Railroad material where material roll width is less than the required width of fabric panel and where indicated. Provide battens and seams as required by railroaded material to produce fabric panels with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of fabric panel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER-SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

B. Electrical Connections: Connect motor-operated roller shades to building electrical system.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 122413

SECTION 123616 - METAL COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes stainless-steel countertops.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

C. Shop Drawings: Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver metal countertops only after casework has been completed in installation areas.

B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of construction to receive metal countertops by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

B. Sealant for Countertops: Manufacturer's standard sealant of characteristics indicated below that complies with applicable requirements in Section 079200 "Joint Sealants."

1. Joint Sealant: Single component, nonsag, neutral curing, silicone; Class 25.
2. Color: Clear.

2.2 STAINLESS-STEEL COUNTERTOPS

A. Countertops: Fabricate from 0.062-inch- (1.59-mm-) thick, stainless-steel sheet. Provide smooth, clean exposed tops and edges in uniform plane, free of defects. Provide front and rear profiles as indiacated on the drawings.

1. Joints: Fabricate countertops without field-made joints.
2. Weld shop-made joints.
3. Sound deaden the undersurface with heavy-build mastic coating.
4. Extend the top and rear down as indicated on the drawings and provide a 1/2-inch (12.7-mm) return flange.

2.3 STAINLESS-STEEL FINISH

A. Grind and polish surfaces to produce uniform, directional satin finish matching No. 4 finish, with no evidence of welds and free of cross scratches. Run grain with long dimension of each piece. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of metal countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install metal countertops level, plumb, and true; shim as required, using concealed shims.

B. Permanently secure tops to plywood substrate .

C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.

D. Seal junctures of tops and walls with silicone sealant recommended by countertop material manufacturer.

3.3 CLEANING AND PROTECTION

A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

C. Protection: Provide 6-mil (0.15-mm) plastic or other suitable water-resistant covering over the countertop surfaces. Tape to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

END OF SECTION 123616

SECTION 123661 - SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid-surface-material countertops and backsplashes.
2. Window sills.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section for credits 16a-38k-4(b)4
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For countertop materials.

C. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

D. Samples for Verification: For the following products:

1. Countertop material, 6 inches (150 mm) square.

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.5 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID-SURFACE-MATERIAL COUNTERTOPS

A. Configuration: Provide countertops with the following front and backsplash style:

1. Front: 3/4-inch (19-mm) bullnose.
2. Backsplash: Straight, slightly eased at corner.
3. Endsplash: Matching backsplash.

B. Countertops: 3/4-inch- (19-mm-) thick, solid surface material with front edge built up with same material.

C. Backsplashes: 3/4-inch- (19-mm-) thick, solid surface material.

D. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.
2. Install integral sink bowls in countertops in the shop.

2.2 COUNTERTOP MATERIALS

A. Adhesives: Adhesives shall not contain urea formaldehyde.

B. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. E. I. du Pont de Nemours and Company.
b. Formica Corporation.
c. Swan Corporation (The).

2. Type: Provide Standard Type unless Special Purpose Type is indicated.
3. Integral Sink Bowls: Comply with ISSFA-2 and ANSI Z124.3, Type 5 or Type 6, without a precoated finish.
   a. Bowl Size: 16 ½ inches wide x 13 inches deep.
4. Colors and Patterns: Equal to Dove, E.I. du Pont de Nemours and Company.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m).

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

1. Install backsplashes and endsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

END OF SECTION 123661

SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roll-up rail mats.
2. Recessed frames.

1.3 COORDINATION

A. Coordinate size and location of recesses in concrete to receive floor mats and frames.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for floor mats and frames.

C. Shop Drawings:

1. Items penetrating floor mats and frames, including door control devices.
2. Divisions between mat sections.
3. Perimeter floor moldings.
4. Custom Graphics: Scale drawing indicating colors.

D. Samples: For the following products, in manufacturer's standard sizes:

1. Floor Mat: Assembled sections of floor mat.
2. Tread Rail: Sample of each type and color.
3. Frame Members: Sample of each type and color.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Entrance Floor Mats and Frames to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 ENTRANCE FLOOR MATS AND FRAMES, GENERAL

A. Structural Performance: Provide roll-up rail mats and frames capable of withstanding the following loads and stresses within limits and under conditions indicated:

1. Uniform floor load of 300 lbf/sq. ft. (14.36 kN/sq. m).
2. Wheel load of 350 lb (159 kg) per wheel.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's and ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.2 ROLL-UP RAIL MATS

A. Basis-of-Design Product: Subject to compliance with requirements, provide FMR-C; Balco, Inc.

B. Roll-up, Aluminum-Rail Hinged Mats: Extruded-aluminum tread rails 2 inches (50 mm) wide by 3/8 inch (9.5 mm) thick, sitting on continuous vinyl cushions.

1. Tread Inserts: 1/4-inch- (6.4-mm-) high, 28-oz./sq. yd. (950-g/sq. m) weight, level-cut, nylon-pile, fusion-bonded carpet.
2. Colors, Textures, and Patterns of Inserts: As selected by Architect from full range of industry colors.
3. Rail Color: Mill finish.
4. Hinges: Aluminum.
5. Mat Size: As indicated.

2.3 FRAMES

A. Recessed Frames: Manufacturer's standard extrusion.

1. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6061-T6 or Alloy 6063-T5, T6, or T52.

a. Color: Mill finish.

2.4 CONCRETE FILL AND GROUT MATERIALS

A. Provide concrete fill and grout equivalent in strength to cast-in-place concrete slabs for recessed mats and frames. Use aggregate no larger than one-third fill thickness.

2.5 FABRICATION

A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

B. Recessed Frames: As indicated, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.

1. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

C. Coat concealed surfaces of aluminum frames that contact cementitious material with manufacturer's standard protective coating.

2.6 ALUMINUM FINISHES

A. Mill finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and floor conditions for compliance with requirements for location, sizes, minimum recess depth, and other conditions affecting installation of floor mats and frames.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install recessed mat frames to comply with manufacturer's written instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate tops of mat surfaces with bottoms of doors that swing across mats to provide clearance between door and mat.

1. Install necessary shims, spacers, and anchorages for proper location, and secure attachment of frames.
2. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.

3.3 PROTECTION

A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 124813

SECTION 129300 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Benches.
2. Tables and Chairs.
3. Trash receptacles.
4. Ash receptacles.

1.2 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

C. Samples: For each exposed product and for each color and texture specified.

D. Samples for Initial Selection: For units with factory-applied finishes.

E. Samples for Verification: For each type of exposed finish, not less than 6-inch- (152-mm-) long linear components and 4-inch- (102-mm-) square sheet components.

F. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For site furnishings to include in the maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Trash Receptacle Inner Containers: Two full-size units for each size indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain bench, table and chairs, litter and ash receptacle and litter receptacle products from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

PART 2 - PRODUCTS

2.1 BENCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Forms+Surfaces.
2. Landscape Forms.
3. Maglin Site Furniture Inc.

B. Frame: Cast aluminum

C. Seat:

1. Material:
   a. Perforated steel.

2. Seat Height: 18” +/-.
3. Seat Surface Shape: Contoured.
4. Overall Height: 18” +/-.
5. Overall Width: 68” +/-.
6. Overall Depth: 18” +/-.
7. Arms: None.

D. Aluminum Finish: Powdercoated.

1. Color: Metallic Silver.

E. Steel Finish: Powdercoated.

1. Color: Metallic Silver.

F. Surface Mount Hardware: Provide paver adapters to mount bench to concrete slab below unit paver pavement.

2.2 TABLES AND CHAIRS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Forms+Surfaces.
2. Landscape Forms.

3. Maglin Site Furniture Inc.

B. Table Frame: Cast aluminum.

C. Chair:

1. Material:

a. Cast Aluminum.

2. Seat Height: 18” +/-.
3. Seat Surface Shape: Contoured or dished.
4. Overall Height: 33” +/-.
5. Overall Width: 20” +/-.
6. Overall Depth: 21” +/-.
7. Arms: None.
8. Seating Configuration: Multiple units, four chairs per table.

D. Table Top:

1. Material:
   a. Steel
2. Surface Shape: Round.
3. Feature: 30” +/- height.

E. Aluminum Finish: Powdercoated.

1. Color: Metallic Silver

F. Steel Finish: Powdercoated.

1. Color: Metallic Silver.

2.3 LITTER AND ASH RECEPTACLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Forms+Surfaces.
2. Landscape Forms.
3. Maglin Site Furniture Inc.

B. Steel Facing Surrounds: Perforated-steel sheet.

C. Support Frames: Steel.

D. Litter and Ash Receptacles:

1. Receptacle Shape and Form: Round cylinder; with opening for depositing trash in receptacle side.

2. Ash Receptacle Function: Uncovered receptacle with sand pan for depositing cigarette butts; fire-proof design; bowl and pan removable for cleaning.
3. Inner Container: Rigid plastic container with drain holes; designed to be removable and reusable.
4. Disposable Liners: Provide receptacle designed to accommodate disposable liners.
5. Capacity: Not less than 30 gal. (114 L).
6. Service Access: Basket pivots forward for trash removal.
7. Post Mount: Color-coated steel pipe; color to match receptacle.

E. Steel Finish: Powdercoated.

1. Color: Metallic Silver.

2.4 LITTER RECEPTACLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Forms+Surfaces.
2. Landscape Forms.
3. Maglin Site Furniture Inc.

B. Support Frames: Cast aluminum.

C. Litter Receptacles:

1. Receptacle Shape and Form: Shape and form shall closely match litter and ash receptacle; with opening for depositing trash in lid or top.
2. Inner Container: Rigid plastic container with drain holes.
3. Disposable Liners: Provide receptacle designed to accommodate disposable liners.
4. Capacity: 30 gal. (114 L).
5. Service Access: Basket pivots forward for trash removal.

D. Aluminum Finish: Powdercoated.

1. Color: Metallic Silver

2.5 FABRICATION

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.

C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section

of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

E. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.6 GENERAL FINISH REQUIREMENTS

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.8 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel, Powder-Coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored or positioned as indicated at locations indicated on Drawings.

D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

END OF SECTION 129300

SECTION 131200 - CANOPIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Freestanding, pre-engineered metal canopies including concrete foundation, steel framing, metal roof, roof drains and leaders, fascia components, and metal ceiling and accessories.

1.2 RELATED SECTIONS

A. Section 033000 – “Cast-In-Place Concrete”.

B. Section 055000 – “Metal Fabrications” for Pipe Bollards.

C. Section 079200 – “Joint Sealants”.

D. Division 11 – “Equipment” for fueling system equipment.

E. Division 21 – “Fire Suppression” for fire suppression system.

F. Division 26 – “Electrical” for electrical wiring and connections.

1.3 REFERENCES

A. American Institute of Steel Construction, Inc. (AISC): AISC 360 - Specification for Structural Steel Buildings (copyrighted by AISC, ANSI approved).

B. American Society of Civil Engineers (ASCE): ASCE 7 - Minimum Design Loads for Buildings and Other Structures (copyrighted by ASCE, ANSI approved).

C. American Welding Society (AWS): AWS D1.1 - Structural Welding Code - Steel (copyrighted by AWS, ANSI approved).

D. ASTM International (ASTM):
1. ASTM A 36/A 36M - Standard Specification for Structural Steel.

E. National Association of Architectural Metal Manufacturers (NAAMM): NAAMM MFM - Metal Finishes Manual.

F. National Fire Protection Association (NFPA): NFPA 70 - National Electrical Code (copyrighted by NFPA, ANSI approved) - hereinafter referred to as NEC.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide pre-engineered canopies capable of withstanding the effects of gravity loads and the following loads and stresses per the 2005 Connecticut Supplement with 2009 Amendment State Building Code:
1. Uniform pressure as indicated on drawings - minimum design wind load per ASCE 7, CH. 6.

B. Thermal Movements: Provide pre-engineered canopies that allow for thermal

movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 degrees F (67 degrees C), ambient; 180 degrees F (100 degrees C), material surfaces.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Submit manufacturer's data sheets on each product to be used.

C. Shop Drawings: for the following metal canopy system components, including all design documents. Include plans, elevations, sections, details and attachments to other work:

1. Drawings shall show specific application to this Project. Submit all required drawings in one submission, except as noted.
   a. Erection Drawings: Manufacturer’s complete erection drawings. Indicate manufacturer’s identification marking for the components.
   b. Manufacturer’s drawings showing base plate dimensions and foundation loads for all columns and /or rigid frames.
      1) Manufacturer’s standard sheets showing loads or details for a multiple range of building spans, heights, and loadings will not be accepted.
   c. Foundation drawings showing dimensions and elevations of all piers, walls, and footings required.
   d. Anchor-Bolt Plans: Submit anchor-bolt plans and templates before foundation work begins. Include location, diameter, and projection of anchor bolts required to attach all columns and/or rigid frames to foundation. Indicate column reactions at each location.
   e. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
   f. Metal Canopy Panel Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
   g. Anchor bolt and tie rod details.
   h. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches (1:8).
      1) Flashing and trim.
      2) Gutters.
      3) Downspouts.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below:

1. Metal Panels: Nominal 12 inches (300 mm) long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
2. Flashing and Trim: Nominal 12 inches (300 mm) long. Include fasteners and other exposed accessories.
3. Accessories: Normal 12-inch-(300-mm)-ling Samples for each type of accessory.

E. Delegated-Design Submittal: For metal building systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer, licensed in the State of Connecticut, responsible for their preparation.

F. Quality Control Submittals:
1. Design Calculations: Manufacturer's design calculations signed and sealed by a professional engineer, licensed in the State of Connecticut, for the entire canopy structure and foundation.

G. Field quality-control reports.

H. Warranties: Sample of special warranties.

I. Maintenance Data: For metal panel finishes to include in maintenance manuals.

J. Certificates: Submit product certificates signed by the manufacturer certifying material compliance with specified performance characteristics and criteria, and physical requirements.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Canopies to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

B. Warranty: For Canopies specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in engineering and manufacturing pre-engineered canopies with a minimum documented experience of twenty years and with a quality assurance program utilizing a quality inspection for each system.
1. Engineering Responsibility: preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.

A. Welding: Qualify procedures and personnel according to the following:
1. Welding shall be in accordance with AWS D1.1 (with E70XX electrodes).

2. Steel shop connections shall be welded and field connections shall be bolted (unless otherwise noted on the Drawings). Shop welds may be changed to field welds with the approval of the project engineer.
3. Slag shall be cleaned from welds and inspected. Steel shall be painted with red oxide rust-inhibitive primer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NEC, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Source Limitations: Obtain pre-engineered metal canopy through one source from a single manufacturer who shall manufacture and install the canopy.

D. Product Options:
1. Information on the Drawings and in the Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance. Do not modify intended aesthetic effects, as judged solely by the Architect, except with the Architect's approval. If modifications are proposed, submit comprehensive explanatory data to the Architect for review.
2. The Drawings indicate size, profiles, and dimensional requirements of pre-engineered metal canopies and are based on the specific system indicated. Do not modify intended aesthetic effects, as judged solely by the Architect, except with the Architect's approval. If modifications are proposed, submit comprehensive explanatory data to the Architect for review.

E. Coordination:
1. The Contractor shall conduct site meetings to verify project requirements, substrate conditions, utility connections, manufacturer's drawings and installation instructions.
2. The contractor shall prepare for and pour the concrete footers for the pre-engineered metal canopies. Manufacturer shall furnish recommended footing drawings and prints and rebar details for concrete footings, as well as provide anchor bolts to be embedded in concrete footer. Such items shall be delivered to project site in time for installation.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Protect components and accessories from corrosion, deformation, damage, and deterioration when stored at job site. Keep materials free from dirt and foreign matter.

1.9 PROJECT CONDITIONS

A. Field Measurements: The Contractor shall verify location and elevation of footings relative to finished grade, columns, and other construction contiguous with pre-

engineered metal canopies by field measurements before fabrication and indicate measurements on shop drawings.

B. Weather Limitations: Proceed with installation only when weather conditions permit metal panels to be installed according to manufacturer’s written instructions and warranty requirements.

1.10 WARRANTY

A. Manufacturer shall warranty materials and products free of defects and leaks and for a period of 1 year from the date of shipment.

1. Finish warranty: 20 years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide product by Austin Mohawk and Company, Inc.

2.2 MATERIALS

A. Structural Steel:
   1. Material and work shall conform to the latest AISC 360.
   2. Structural steel shall be painted with a rust inhibitive (red oxide) primer (std).

B. Sheet Metal:
   1. Decking: 3 inch (76 mm) by 16 inch (406 mm) by 20 gage smooth white, ASTM A 653/A 653M GR40, Fy = 40 ksi, galvanized steel with baked enamel finish.
   2. Center and Tapered Gutter: 24 gage hot-dip galvanized steel baked enamel finish.
   3. Perimeter Gutter: 20 gage hot-dip galvanized steel baked enamel finish.
   4. Internal Downspout: 3 inch (76 mm) diameter PVC.
   5. External Downspouts: 3 inch (76 mm) by 4 inch (102 mm) by 24 gage hot-dip galvanized steel with baked enamel finish.

2.3 PRE-ENGINEERED METAL CANOPY

A. General: Provide a complete, integrated set of manufacturer's standard design canopy components to form a pre-engineered canopy. The pre-engineered metal canopy shall be designed to meet all structural wind, snow and seismic requirements.

B. Canopy Fascia:
   1. Aluminum Composite Panel (ACM) with fluorocarbon paint finish, masked on one side. Shall be warranted for 20 years.

C. Canopy Finishes: Comply with NAAMM MFM for recommendations for applying

and designating finishes.

1. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

D. Fabrication: Fabricate pre-engineered canopies completely in factory.

E. Seismic Performance: Metal building systems shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

F. Wind-Uplift Resistance: provide metal roof panel assemblies that comply with UL 580 for Class 90.

G. Design Load: 30 psf.

H. Maximum Deflection: 1/140 of the span.

I. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.

PART 3 EXECUTION

3.1 FABRICATION

A. General: Design components and field connections required for erection to permit easy assembly.

B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.

C. Primary Framing: Shop fabricate framing components to indicate size and section, with baseplates, bearing plates, stiffeners and other items required for erection welded into place. Cut, form, punch, drill and weld framing for bolted field assembly.

1. Make shop connections by welding or by using high-strength bolts.
2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
3. Brace compression flange if primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
4. Weld clips to frames for attaching secondary framing.
5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.

D. Secondary Framing: Shop fabricate framing componants to indicate size and section by roll-forming or break-forming, with baseplates, bearing plates, stiffners and other

plates required for erection welded into place. Cut, form, patch, drill and weld secondary framing for bolted field connection to primary framing.

1. Make shop connections by welding or by using non-high-strength bolts.
2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.

3.2 EXAMINATION

A. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Architect, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

1. Examine supporting foundations and anchor bolts for compliance with manufacturer's requirements, including installation tolerances and other conditions affecting performance of supporting members.
2. Verify the rough-in of required mechanical and electrical services prior to placement of the structure.
3. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the installer.

3.3 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Provide temporary shores, guys, braces and other supports during erection to keep structural framing secure, plumb and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections and bracing are in place unless otherwise indicated.

3.4 INSTALLATION

A. A work area shall be required extending 10 feet (3 m) beyond buildings and canopies in all directions to the extent practical. The work area shall be flat, comprised of hard-packed soil or gravel, asphalt, or concrete, and free of open excavation, debris, construction equipment and construction workers. An additional flat work space a minimum of 25 feet (7.6 m) by 25 feet (7.6 m) or as practical shall be provided adjacent to the canopy and/or building for unloading and storing materials. Site to meet OSHA guidelines to allow lift equipment and scaffolding to maneuver the work area.

B. Set pre-engineered metal canopy plumb and aligned. Level base plates true to plane with full bearing on concrete bases.

C. Fasten pre-engineered metal canopy columns to anchor bolts and/or foundation bolts.

D. Provide anchor bolts as follows:
   1. Set anchor bolts or foundation bolts in strict accordance with approved shop drawings. Use of a plywood template is recommended. Remove template prior to column erection.
   2. Anchor bolts shall conform to ASTM A 307, and shall have a minimum of 7 inches (178 mm) of exposed thread and 23 inch (584 mm) minimum embedment with 1-1/4 inch (32 mm) nut and washer as embedment end.

E. Provide bolted connections as follows:
   1. Structural erection bolts shall conform to ASTM A 325/A 325M.
   2. Bolts shall be tightened to snug tight per latest RCSC specifications (unless otherwise specified).

F. Provide screws as follows:
   1. Fastening shall be performed per installation prints provided by the manufacturer.
   2. Self-drilling and self-tapping screws shall have a sufficient cut point and a 1/2 inch (13 mm) outside diameter dished metal-backed neoprene washer to be used in water sealing applications.

G. Provide pedestrian protection and warnings during construction which comply with local, Federal, and OSHA codes.

H. Prior to steel erection of any kind, the Contractor shall grade, backfill and otherwise prepare the job site to allow for rolling scaffold and ensure safe working conditions including the removal or relocation of overhead power lines.

I. Any grade or elevation situations which deviate from the approved manufacturer's plans shall be conveyed to the manufacturer prior to fabrication.

J. All anchor bolts and/or leveling plates shall be set within 1/4 inch (6 mm) tolerance on layout and grade level.

K. Temporary electrical power shall be provided.

L. Connect electrical power service to power distribution system according to requirements specified in Division 26 - Electrical.

M. Dumpster for trash and debris shall be provided by the Contractor.

3.5 ADJUSTING AND CLEANING

A. After completing installation, inspect exposed finishes and repair damaged finishes.
   1. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer’s written instructions.
   2. Touchup Painting: After erection, promptly clean, prepare and prime or re-prime field connections, rust spots and abraded surfaces if prime-painted structural framing, bearing plates and accessories.

B. Erect and install the canopy and appurtenances in accordance with the manufacturer's printed instructions except as otherwise specified. Install the work of this Section so the structure is secure and weather tight and exposed materials are free of visible dents, scratches, tool marks, cuts and other imperfections. Install system free of rattles, wind whistles and noise due to thermal movement.

3.6 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION 131200

SECTION 142100 – MACHINE- ROOM-LESS ELECTRIC TRACTION ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Electric geared traction elevators, machinery and operating equipment.

B. Related Sections:

1. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
2. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
3. Section 055000 "Metal Fabrications" for the following:
   a. Attachment plates and angle brackets for supporting guide-rail brackets.
   b. Structural-steel shapes for subsills.
   c. Pit ladders.
   d. Cants in hoistways made from steel sheet.
   e. Hoist beams
4. Section 071616 “Crystalline Waterproofing” for waterproofing of elevator pits.
5. Section 271500 "Communications Horizontal Cabling" for telephone service for elevators.
6. Section 282304 “Indoor and Outdoor Surveillance CCTV System” for security cameras installed in elevator cab.
7. Section 283100 " Addressable Fire-Alarm Detection System" for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.

1.3 DEFINITIONS

A. Definitions in ASME A17.1 apply to work of this Section.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Professional Certification: Provide Shop Drawings and engineering calculations, which indicate loading requirements on structural elements of building, prepared and sealed by a Registered Professional Engineer, licensed in the State of Connecticut.

C. Product Data: Submit for each elevator, include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control system, environmental limitations and signal systems.

D. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details of each elevator cab and hoistway entrance, indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
2. Include large-scale layout of car-control station and standby power operation control panel.
3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
4. Complete wiring diagrams of system circuits and controls.
5. Rail bracket spacing and maximum loads on guide rails.
6. Weights of principal components.
7. Loads on hoisting beams.
8. Member sizes.
9. Power configuration data, including horsepower, voltage and amperage requirements, starting current. Full load running current and demand factor for applicable motors. Include maximum and average power demands.
10. Variations from specified requirements.
11. Seismic requirements.

E. Samples for Initial Selection: For finishes involving color selection.

F. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 3-inch (75-mm) square Samples of sheet materials; and 4-inch (100-mm) lengths of running trim members.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service including standby power generator, as shown and specified, are adequate for elevator system being provided.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

1. Maintenance Data: For Machine-Room-Less Electrical Traction Elevators to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS. Include the following:

2. Submit operation, cleaning and maintenance data for materials and systems provided.
3. Include description of elevator system method of operation and control, including door operation, signals, fire fighter's service, emergency power operation, and other special or non-standard features provided.
4. Provide parts catalogs with complete list of equipment replacement parts with equipment description and identifying numbers.
5. Provide legible schematic wiring diagrams covering electrical equipment installed, including changes made in final Work, with symbols listed corresponding to identity or markings on both machine room and hoistway apparatus.
6. Provide following maintenance details:

    a. Lubrication chart.
    b. Trouble shooting procedures.
    c. Adjustment techniques.
    d. Operating checks.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

D. Warranty: For Machine-Room-Less Electric Traction Elevators specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

B. Designer/Engineer Qualifications: Design components with loading requirements on structural elements of building under direct supervision of a Registered Professional Engineer, licensed in the State of Connecticut.

C. Maintenance Personnel Qualifications: Employees of elevator installer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.9 COORDINATION

A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

B. Coordinate sequence of elevator installation with other work to avoid delaying the work.

C. Coordinate locations and dimensions of other work relating to elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.10 PROJECT CONDITIONS

A. Verify dimensions of supporting structure at site by accurate field measurements so that elevator Work will be accurately fabricated and fitted to structure and that clearances and alignments are proper for installation of Work.

B. Provide for erection tolerances corresponding with specified tolerances for other Work where field measurements cannot be obtained.

C. Remedy unsatisfactory tolerances in adjoining Work.

1.11 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
2. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Ecospace by Kone Inc.

B. Source Limitations: Obtain elevators from single manufacturer.

1. Major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Comply with requirements of local authority having jurisdiction and any authority which may govern requirements for elevators.

B. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

C. ASME A17.1 "Safety Code for Elevators and Escalators".

D. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1 – 2003 w/ 2009 State of Connecticut amendment.

E. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
2. Provide earthquake equipment required by ASME A17.1/CSA B44.
3. Provide seismic switch required by ASCE/SEI 7.
4. Design earthquake spectral response acceleration short period (Sds) for Project: See Structural Drawings.
5. Seismic design category is determined by Project's occupancy category and design earthquake spectral response acceleration coefficients (Sds and Sd1).
6. Project's Seismic Design Category: See Structural Drawings.
7. Elevator Component Importance Factor: See Structural Drawings.

2.3 MATERIALS

A. Carbon Steel: ASTM A1008, cold rolled, commercial quality sheet steel, free from scale, pitting or other defects; matte finish and stretcher leveled.

B. Finish Materials: As indicated in subsequent sections.

C. Light Fixtures: As selected by Architect from manufacturers standards.

D. Protection Pads and Buttons:

1. Type: Flame resistant fabric and filling with sufficient stitching to prevent sagging of filling.
2. Attachment devices: Manufacturer's standard stainless steel buttons and grommets.
3. Cutouts: Provide cutouts for control stations and other signal devices.

2.4 EQUIPMENT

A. Motors, Controller, Controls, Buttons, Wiring, Devices, and Indicators: UL approved

B. Microprocessor:

1. Provide elevator manufacturer's microprocessor-based control system with software suitable for intended building occupancy to perform car operational control and hardware necessary to connect, transfer and interrupt power and protect motor against overloading.
2. Properly shield each controller cabinet containing memory equipment from line pollution.
3. Design microprocessor system to accept re-programming with minimum down time.

C. General Operational Control:

1. Operate without attendants as group and be capable of balancing service and continuing operation with one or more cars removed from system.
2. Provide means to periodically review and modify assignments to improve service.

D. Elevator Machine: AC gearless traction machine, with permanent magnet synchronous motor, direct current electro-mechanical disc brakes, and integral traction drive sheave, mounted to the car guide rail at the top of the hoistway.

E. Drive: Provide variable voltage variable frequency AC drive system to develop high starting torque with low starting current.

F. Controller Location: Locate controller in an integral cabinet adjacent to the entrance frame at the top landing of the elevator. See floor plans for controller location.

G. Hoisting Motor:

1. Reversible motor with high starting torque and low starting current designed to withstand severe loads encountered in elevator service; rated for 30 minutes, conforming to NEMA standards.
2. Provide Class A insulation for 50..-C rise.
3. Provide sufficient capacity to operate with contract load at contract speed.
4. Provide motor starting controls such that under no circumstances shall motor starting current exceed 3.0 times motor full load current.

H. Voltage Control:

1. Provide elevator manufacturer's solid-state power converters.
2. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.

I. Guide Rails, Ropes, Cables, Counterweights, Sheaves, Buffers, Attachment Brackets and Supports, and Anchors: Designed and sized according to code with applicable safety factors.

2.5 COMPONENTS AND FABRICATION

A. Electrical Components:

1. Fittings: Steel compression type for electrical metallic tubing; fittings with set screws are acceptable only when separate grounding conductor is installed across joint.
2. Do not parallel conductors to increase current carrying capacity unless individually fused.
3. Do not use armored flexible metal conduit as grounding conductor.
4. Provide additional disconnect switches and wiring to suit machine room layout.
5. Include wiring and connections to elevator devices remote from hoistway and between elevator machine.

B. Cars:
1. Frame and platform:
   a. Construct frame of structural or formed steel members.
   b. Construct platform of steel reinforcing with plywood or steel plate subfloor components.
   c. Mount platform on resilient pads.
2. Shells:
   a. Fabricate from manufacturer's standard gage sheet steel for walls and canopy, suitably reinforced for rigidity and cut out for accessories and panels.
   b. Make joints between panels vertical, flush, even and light tight.
   c. Provide vents at bottom of panels.
   d. Provide sound deadening at backs of panels.
   e. Provide black finish on panel recesses and corner straps.
   f. Reinforce canopy/ceiling construction as necessary to maintain loads applied during car top inspection.
   g. Provide car top emergency and inspection hatches as required by code. h. Provide side emergency access panels as required by code.
   i. Provide car top railings as required by code.
3. Door panels:
   a. Flush hollow metal construction, minimum 16 gage (1.5 mm thick) sheet steel, sound deadened, minimum 1 inch (25 mm) thickness.
   b. Reinforce by continuous vertical reinforcing as required for adequate support and surface flatness for configurations indicated.
   c. Provide each door panel with 2 accurately machined guides of design that will permit replacement without removal of doors.
4. Return panels:
   a. Fixed configuration, suitably reinforced as required for surface flatness and support of equipment cutouts.
   b. Incorporate operating controls, control panel, signals, required signage, certificate holder, telephone cabinets and other features as required, indicated or specified.
5. Sills: Extruded aluminum; manufacturer's standard profile.
6. Ventilation:
   a. Provide exhaust unit with 2-speed operation.
   b. Furnish suitable isolation mountings and sound insulation to provide quiet operation.
7. Emergency lighting: Furnish one emergency light in each cab; manufacturer's standard, unless otherwise indicated.
8. Telephones and cabinets:
   a. Provide one cabinet for each cab, in front return.
   b. Provide one phone for emergency communications, connected to security service (security office) for 24-hour monitoring, as required to comply with authorities having jurisdiction and with requirements of the ADA. Provide telephone with the following features:
      1) Battery back-up system.
      2) Internal speaker and microphone, for use without handset. Mount speaker button 4'-0" maximum above car floor.

3) Emergency communication system shall not require voice communication. At a minimum, provide both audio and visual indication that call has been answered.
4) Field-programmable auto-dial memory and location identification signal device, activated by push button which illuminates when call is answered.
5) Raised tactile lettering in panel, reading "EMERGENCY USE ONLY", and providing instructions for use in both English and Braille.

9. Security Features: Provide the following security features. Security features shall not affect emergency firefighters' service.
   a. Card-Reader Operation: System uses card readers at car-control stations and hall push-button stations to authorize calls. Security system determines which landings and at what times calls require authorization by card reader. Provide required conductors in traveling cable and panel in machine room for interconnecting card readers, other security access system equipment, and elevator controllers. Provide stripe-swipe card reader integral with each car-control station.
      1) Security access system equipment is specified in Section 281300 "Access Control."
   b. Security Camera: Provide required conductors in traveling cable and panel in machine room for interconnecting security camera equipment.
      1) Security camera equipment is specified in Section 282304 "Indoor and Outdoor Surveillance CCTV System."

C. Hoistway Entrances:
1. Fire rating:
   a. Fabricate assemblies as tested and approved by Underwriters' Laboratories or other nationally recognized testing agency approved by authorities having jurisdiction.
   b. Comply with requirements of NFPA 80.
   c. Comply with requirements of ASTM E152, NFPA 252m or UL 10B.
   d. Identify each assembly with factory applied label indicating applicable fire rating.
2. Doors:
   a. Fabricate doors of flush hollow metal construction, minimum 16 gage sheet steel; minimum 1-1/4 inch thick.
   b. Reinforce by continuous vertical reinforcing as required for adequate support and surface flatness for configurations indicated.
   c. Provide sight guards formed of minimum 16 gage steel, finish to match exposed door finish.
3. Frames:
   a. Fabricate frames of hollow metal construction, minimum 16 gage sheet steel with sound deadening material applied to back surface.
   b. Where gypsum board hoistway partitions are indicated, fabricate frames with reinforced head sections.
   c. Provide sizes and profiles indicated.
4. Sills: Extruded aluminum; manufacturer's standard profile.

D. Hoistway and Cab Door Operators:
1. General:
   a. Provide adjustable heavy-duty electric operators designed to smoothly open and close cab and hoistway doors simultaneously.
   b. Standing time:
      1) Normal time doors remain open after stopping for demand: Separately adjustable for car calls and landing calls, and capable of adjustment from minimum of 3 seconds to 30 seconds after doors reach fully open position.

2) Initial adjustment: Set to minimum time equal to distance/1.5 feet per second for car call and 5.0 seconds for landing call.

2. Door safety devices: Provide safety device with uniform array of 36 or more microprocessor-controlled infrared light beams projecting across car entrance. Interruption of one or more beams shall cause doors to stop and re-open.

2.6 SHOP FINISHES

A. General: Finishes to match Architect's samples.

B. Cab Finishes:
1. Material: Stainless steel.
2. Basis-of-Design: Stainless Steel Series, Autumn, by Kone.

C. Handrails:
1. Material: Stainless steel.
2. Shape: Flat, 2 inch high.

D. Ceiling:
1 . Stainless steel with (6) square LED fixtures.
2. Basis-of-Design: Model LF-97 by Kone.

E. Signalization:
1 . Stainless steel.
2. Basis-of-Design: Model KSS570 by Kone.

F. Cab floors:
1. Elevator B: Floor recessed and prepared to receive Resinous Matrix Terrazzo Flooring specified in section 096623 “Resinous Matrix Terrazzo Flooring “.

2. Elevator C: Floor prepared to receive vinyl composition tile specified in section 096519 “Resilient Tile Flooring”.

2.7 CONTROLS, SIGNALS AND SIGNAGE

A. Cab Controls and Signals:
1. Car operating panel in front return:
a. General:
1) Provide manufacturer's standard panel.
2) Incorporate car operating controls, control panel, signals, signage, certificate holder, telephone cabinet, and other features.
3) Provide one operating panel per cab.
b. Buttons:
1) Manufacturer's standard flush illuminated buttons of minimum 3/4 inch diameter, corresponding to each landing served, "door open" and "door close".
2) When pressed buttons illuminate and remain illuminated until call is answered.
c. Additional controls: Emergency call buttons, stop switch, fire department keyed switch.
d. Provide raised markings and Grade 2 braille to left of each button, in compliance with ADA; markings and braille shall be black on stainless steel plate of same

finish as front return panels.

e. Conceal switches for lighting, top-of-car inspection and fan in panel.

f. Provide fully connected phone for emergency communications equipment in telephone cabinet.

2. Car position indicators:

a. Digital type, with minimum 1/2 inch high numerals.

b. Mount over car operating panels.

c. As car passes each floor and as car stops at a floor, the corresponding numerals shall illuminate and an audible signal shall sound. Audible signal in car shall sound minimum of 5 seconds before doors open.

B. Hall Buttons:

1. At each terminal landing, provide single push button.
2. At each intermediate landing, provide button fixture containing "UP" and "DOWN" push buttons.
3. Provide one hall button for each elevator.
4. Buttons:
   a. Manufacturer's standard flush illuminated buttons of minimum 3/4 inch diameter.
   b. When pressed, buttons illuminate and remain illuminated until call is answered.
5. Provide raised markings and Grade 2 braille to left of each button, in compliance with ADA; markings and braille shall be black on stainless steel plate of same finish as call button plate.
6. Configurations and finishes: Mount in manufacturer's standard satin finish stainless steel plate.

C. Hall Lanterns:

1. Direction lantern illuminating white for up and red for down, adjacent to each hoistway entrance.
2. Lantern illuminates indicating direction of travel.
3. Audible signal:
   a. Provide lantern with gong sound approximately four seconds before car door opening; once for up direction, twice for down direction.
   b. Equip gong with adjustable volume.
   c. Permit gong to sound in response to hall calls but not in response to car calls.
4. Faceplate material: Manufacturer's standard satin stainless steel.

D. Emergency and Braille/Number Signage:

1. General: Provide as required by authorities having jurisdiction.
2. Emergency signage:
   a. Cabs: Text shall be engraved in stainless steel front return panel, with etched letters infilled with black enamel.
   b. Halls: Text shall be etched in satin stainless steel plate below hall buttons, with etched letters infilled with black enamel.
3. Cab braille/number signage: As specified above under "Cab Controls".
4. Hall braille/number signage: As specified above under "Hall Buttons".
5. Hoistway jamb braille/number plates:
   a. Provide combination braille/number plates on both sides of each hoistway entrance, to identify floor. Characters shall be at least 2 inches high.
   b. Permanently mount plates using adhesive, centered in frame width and 5'-0" to center of jamb plate above finish floor. Exposed fasteners are not acceptable.

2.8 ELEVATOR SCHEDULE

A. Description – Elevator ‘B’:
   1. Machine Location: Hoistway; no machine room is provided.
   2. Rated Load: 3500 lb (1588 kg).
   3. Rated Speed: 150 fpm (0.76 mps).
   4. Landings: 3 .
   5. Openings: 3 front, 0 back.
   6. Travel: 2 8 '-0"
   7. Operation System: Simplex.
   8. Clear Inside Dimensions (W x D): 6'-8" x 5'-7"
   9. Cab Height: 9'
   10. Clear height under suspended ceiling: 8'-7"
   11. Entrance Width & Type: 3 ’ - 6 ” & as shown.
   12. Entrance Height: 8'
   13. Main Power Supply: 480 Volts.
   14. Machine Location: Inside the hoistway mounted on car guide rail
   15. Control Space Location: Adjacent Room.
   16. Sills: Nickel silver, polished.
   17. Hall Fixtures: Satin stainless steel, No. 4 finish.
   18. Additional Requirements:
      a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
      b. Provide hooks for protective pads and one complete set(s) of full-height protective pads.

B. Description – Elevator ‘C’:
   1. Machine Location: Hoistway; no machine room is provided.
   2. Rated Load: 3500 lb (1588 kg).
   3. Rated Speed: 150 fpm (0.76 mps).
   4. Landings: 3 .
   5. Openings: 2 front, 1 back.
   6. Travel: 28'-0"
   7. Operation System: Simplex.
   8. Clear Inside Dimensions (W x D): 6'-8" x 5'-7"
   9. Cab Height: 9'
   10. Clear height under suspended ceiling: 8'-7"
   11. Entrance Width & Type: 3 ’ - 6 ” & as shown.
   12. Entrance Height: 8'
   13. Main Power Supply: 480 Volts.
   14. Machine Location: Inside the hoistway mounted on car guide rail
   15. Control Space Location: Adjacent Room
   16. Sills: Nickel silver, polished.
   17. Hall Fixtures: Satin stainless steel, No. 4 finish.
   18. Additional Requirements:
      a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
      b. Provide hooks for protective pads and one complete set(s) of full-height protective pads.

2.9 FABRICATION

A. Fabricate and assemble various parts in shop to minimize field assembly.

B. Trial assemble parts which cannot be shop assembled and which require close field fit; mark for field erection.

C. Do not permit name plates or logos identifying manufacturer to be visible to general public.

D. Provide concealed fasteners on surfaces exposed to public view.

E. Factory finish components concealed from public view with manufacturer's standard finish systems.

2.10 ELEVATOR OPERATIONS

A. General: Provide operations specified in related Sections in addition to operations specified in this Section.

B. Fire Emergency Operation:
   1. Provide in accordance with requirements of local authorities and ASME A17.1.
   2. Connect elevators to auxiliary (isolated) contacts of smoke and heat sensing devices. When smoke is detected by elevator lobby or elevator machine room devices, registered calls for associated elevators are canceled and cars automatically return to designated Fire Floor. If smoke is detected on Fire Floor, cars stop on floor above Fire Floor.
   3. Designated Fire Floor: Unless otherwise determined by Fire Marshall, provide as scheduled above.
   4. Cab provisions: Provide three-position keyed switch in each cab in one of cab control panels to provide for fireman's access.
   5. Hoistway entrance provisions:
      a. Provide manufacturer's standard three-position key switch at designated Fire Floor for each group of elevators.
      b. Locate adjacent to one hall call button for each group, unless otherwise required by Fire Marshall.
      c. Provide with manufacturer's standard, surface mounted key box (for key required to call or operate elevators); mount where directed by Fire Marshall.
      d. Match finish of key switch plate and key box with finish of hall call button plate and engrave to read "EMERGENCY ONLY".
   6. Fire emergency control and operation must be approved by Fire Marshall prior to fabrication.

1. C. Emergency Power Operation: Provide battery powered lowering for each elevator, capable of providing power to lower car to First Floor after loss of normal power, open doors, and operate lights in car to maintain minimum footcandle levels required by Code. System includes rechargeable battery and automatic recharging system.

D. Independent Service Operation:
   1. Provide keyed switch in car station of each elevator for independent service operation.
   2. When switch is turned to "SERVICE" position, it shall cancel previously registered car calls for that elevator, transfer corridor calls to other elevators and permit operation of elevator in response to calls registered from car buttons only.
   3. When switch is turned to "OFF" position, elevator will return to normal operation.

2.11 CONTROL/ INDICATOR PANELS

A. Supervisory Control Panels: Provide manufacturer's standard panels located in elevator remote closet.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.

B. Verify that hoistways, pits, and equipment rooms comply with applicable standards and requirements of Contract Documents.

C. Review and approve structural tolerances, location of structural supports, miscellaneous metal fabrications, pit ladders, hoistway construction, heating, ventilating and air conditioning of equipment rooms; ventilating of hoistways; and electrical power, lighting and outlets required for elevator Work.

D. Verify that sill support angles are properly installed.

E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install components of each elevator system in accordance with final Shop Drawings, manufacturer's written instructions and requirements of ASME A17.1.

B. Machine Equipment:
   1. Install with clearances complying with referenced codes and specifications.
   2. Install items to allow removal by portable hoists or other means for maintenance and repair.
   3. Install items so that maintenance access is safe and readily available.

C. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.

D. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

E. Install piping above the floor, where possible. Install underground piping in casing.

F. Lubricate operating parts of systems as recommended by manufacturers.

G. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

H. Leveling Tolerance: 1/4 inch (6 mm), up or down, regardless of load and travel direction.

I. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

J. Locate hall signal equipment for elevators as follows, unless otherwise indicated:

1. Place hall lanterns above each hoistway entrance.
2. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies. The contractor shall arrange and pay for these tests.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

C. Test Results: In test conditions, ensure speed and performance times specified be met, leveling accuracy maintained without releveling, and general riding quality is acceptable to Owner.

D. Performance Adjustments:
1. Should tests uncover defects or poor workmanship, variance or noncompliance with requirements of specified codes and ordinances or variance or noncompliance with specified requirements, complete following Work and repairs at no additional expense to Owner.
2. Replace equipment that does not meet ASME A17.1 or specified requirements.
3. Perform Work and furnish materials and equipment necessary to complete specified operation and performance.
4. Perform retesting required by governing authority and Owner to verify specified operation or performance.

3.4 ADJUSTING

A. Balance cars to equalize pressure of roller guide shoes on rails.

B. Adjust motors, pumps, valves, generators, brakes, controllers, leveling switches, limit switches, stopping switches, door operators, interlocks, safety devices and other components to achieve required performance levels.

C. Adjust car movement on aligned guide rails to provide smooth movement, with no perceptible lateral or oscillating movement or vibration.

3.5 ADJUSTING

A. Keep Work areas orderly and free from debris.

B. Remove loose materials and filings resulting from Work within hoistways.

C. Clean machine room equipment and floor of dirt, oil and grease.

D. Remove temporary protection and clean hoistway, car, cab enclosures, entrances, operating and signal fixtures, handrails and trim to remove dirt, oil, grease and finger marks.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate elevator(s).

B. Check operation of each elevator with Owner's personnel present before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

3.7 PROTECTION

A. Temporary Use: Limit temporary use for construction purposes to one elevator. Comply with the following requirements for each elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

B. Elevators not used for construction purposes:

1. At time of substantial completion of elevator Work, provide suitable protective coverings, barriers, devices, signs or such other methods or procedures to protect elevator Work from damage or deterioration.
2. Maintain protective measures throughout remainder of construction period so that elevator systems and components will be without any evidence of damage or use at time of acceptance.

3.8 MAINTENANCE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance during normal working hours.
2. Perform emergency callback service during normal working hours with response time of two hours or less.

END OF SECTION 142100

SECTION 143000-CRANES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

The General Provisions of the Contract, including General and Special Conditions, apply to the Work in this Section.

1.2 WORK INCLUDED

A. Equipment items as listed below by Equipment Mark Number:

1. CRANE, BRIDGE, FREE STANDING, 1 TON
Equipment Mark Number: 5074
Submittal requirements: PD, OM, SD, T

2. CRANE, JIB, BASE MOUNTED, 12’, 1 TON
Equipment Mark Number: 5080
Submittal requirements: PD, OM, SD, T

3. CRANE, PORTABLE, 2 TON
Equipment Mark Number: 5280
Submittal requirements: PD, OM

4. HOIST, CHAIN, ELECT., 1 TON
Equipment Mark Number: 5362
Submittal requirements: PD, OM

B. Provide roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.

1. Coordinate and verify all electrical, foundation, and utility connections with all trades prior to equipment ordering and purchase.

C. Wiring and switching between equipment and utilities.

1.3 QUALITY ASSURANCE

A. Experience: Equipment shall be produced by a manufacturer of established reputation with a minimum of five years experience supplying specified equipment.

B. Each product shall be provided by a single manufacturer.

C. All components shall be fully tested and documented to operate as a complete system

D. Manufacturer's Representative: The manufacturer authorized representative shall be factory trained and certified personnel providing service, startup, and quality control field labor for the project from their local office.

1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out and start up.

2. Training: Provide technical representative to train Owner's maintenance personnel in operation and maintenance of specified equipment

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. Refer to above submittal requirements. The following abbreviations are used to identify submittals required:

1. PD- Product Data

2. SD- Shop drawings

3. OM- Operation and Maintenance manual

4. T- Training of owners personnel on specific equipment items

C. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical requirements, wiring diagrams, and provided accessories.

1. Submit Product Data in accordance with Division 1 - General Requirements of these specifications.

2. Restrict submitted material to pertinent data. For instance, do not include manufacturer's complete catalog when pertinent information is contained on a single page.

D. Shop drawings and schematics detailing fabrication, installation, piping layout, materials and finishes, system interconnections, and utility connections of equipment assemblies. Indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection

1.5 INFORMATION SUBMITTALS

A. Delegated-design submittal: For equipment supports, foundations, structure, and capacities to comply with performance requirements and design criteria, including analysis data signed and sealed by a qualified professional engineer responsible for their preparation

B. Factory tests and inspection reports prior to shipping.

C. Field test and start-up reports, indicating and interpreting test results relative to compliance with specified requirements, for information.

D. Certificates: For certification required in "Quality Assurance" Article

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For the equipment identified to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For bus wash systems specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR- CLOSEOUT DOCUMENTS.

1.7 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, function and workmanship unless otherwise noted below.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough, or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.

D. All parts shall be readily available locally in the United States.

E. Any units or parts which prove defective during the warranty period will be replaced with OEM parts and transportation prepaid.

1.8 COORDINATION

A. Coordinate size and location of all foundations, supports, piping, electrical, and controls

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid, dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Mark Number of this specification.

C. Provide equipment and materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

1.10 LABELING

A. Nameplate: Manufacturer shall securely attach in a prominent location on each major item of equipment a non-corrosive nameplate showing manufacturer's name, address, model number, serial number, and pertinent utility or operating data.

B. Crane capacity shall be painted with letters and numbers 3 inches high minimum on both sides of the boom web.

C. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (U.L.), or other National Recognized Testing Laboratory (NRTL), in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant.

PART 2 – PRODUCTS

2.1 CRANE, BRIDGE, FREESTANDING, 1 TON
Equipment Mark Number: 5074

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Columbus McKinnon Lode Rail

B. Warranty: The crane must have a 10 year parts and 1 year labor warranty

C. Capacities and Dimensions:

1. Bridge:

a. Minimum bridge capacity: 1 ton.

b. Bridge length: 17 feet 8 inches.

c. Bridge depth: 14 7/8”

d. Bridge overhang: 1 foot 0 inches on each end of the runway

e. Minimum bridge trolley travel: 14feet 11 3/16 inches.

2. Runway

a. Capacity: 1 ton

b. Length: 53 feet 0 inches

c. Cantilever: 4 feet on each end

d. Overall length: 54 feet 7 inches

e. Runway depth: 15 3/8inches

f. Runway centers width: 15 feet 8 inches

g. Runway sections 28 feet & 25 feet

3. Supports

a. Number of supports: 6 (two assemblies per support center)

b. Support centers length: 25 feet-25 feet

c. Minimum overall height: 18 feet 8 1/2 inches

d. Support centers width: 18 feet 8 inches

e. Minimum overall width: 20 feet 3 1/2 inches

f. Anchor bolt load: 4191 pounds, 6 inch reinforced concrete minimum. Concrete compressive strength 3000 psi required.

4. Festooning

a. Runway carrier: 8 Gliders

b. Festoon clamps: Runway: 1, Bridge: 1

c. Conductor type: Flat cable (4-conductor #14 AWG) 1 pcs @ 80 ft each

d. Bridge carrier

1) Bridge: 1

2) 5-Trolleys

5. Trolley Pin height: 16 feet 0 inches to trolley pin

6. Speeds:

a. Bridge: Manual motion.

b. Trolley: Manual motion.

7. System capacity: 2,000 pounds, maximum.

D. Features and Construction:

1. Bridge: A single girder bridge shall be provided with the system.

a. Materials: The bridge shall consist of cold-rolled steel members welded together with two inch by two inch square tubing welded on top for reinforcement and strength as required. A stack section at one end of a runway shal serve as an extension that allows festoon carriers to be stored on the end of the runway without reducing crane coverage.

2. Runways:

   a. Materials: Track sections shall consist of cold-rolled steel members welded together.

3. Provide 14”x14” base plate welded to each support with 1 inch diameter bolt holes in each corner 11 inches on center.

4. Hoist trolley: Wheel to match the taper of the track to reduce rolling resistance. Wheels to contain ball bearings that are sealed and lubricated for life. Trolleys to be designed to operate in temperatures from +5 degrees F to + 200 degrees F.

5. End trucks: Provide connection between the bridge and runways. Wheels to match the taper of the track to reduce roiling resistance. Two horizontal wheels will center the truck within the runway to prevent binding of the bridge. Any slight runway misalignment is taken up by having the bridge float in one end truck and firmly clamped in the other.

6. Festoon trolleys: Trolleys to have four wheels and a pivoting festoon saddle support.

7. Festoon system: Provide flat cable and festoon system with enough cable for 3 foot loops on the runway and 1 foot 6 inch loops on the bridge.

   a. Trolleys: used to support the flat cable along the runway and bridge

   b. Clamps: used to anchor the festooning at the start of the runway and bridge. Also provided to prevent the festooning trolleys from exiting the track, and provide a redundant stop for the end trucks and trolleys.

8. End stops and Universal bumpers: Provide high impact molded end stop bumpers on the bridge and runways to prevent the end truck and trolley from exiting the track. The bumpers are to be bolted to the track to physically limit the travel of the end truck and trolley.

9. Hoist: Refer to item 5362. Provide one for each bridge crane.

10. Power supply: Power supply shall be provided by power feed end cap consisting of a rubber end pad and an aluminum terminal box with a twist type cable entry gland. Power feed cap shall be pre-assembled with attached plug connectors and jumper wires.

11. Capacity plate: Adhesive PVC foil plates indicating capacity of system shall be attached to both sides of bridge and equally spaced along runway length. Capacity stated on hoist shall be same as capacity indicated on plates.

E. Controls: All protective circuits and components shall meet National Electrical Code requirements.

1. Provide required contactors , relays, and switches to disable power to associated vehicle lift when crane is not in “home” position. Provide a roller type limit switch in the runway to enable/disable the lift. Lift to be enabled when crane is positioned approximately 2 feet from end of runway at the entrance into the maintenance bay. Similarly crane to be disabled when lift is enabled.

F. Finish: Durable, corrosion inhibiting enamel paint with color coded components and zinc-galvanized components where required.

2.2 CRANE, JIB
Equipment Mark Number: 5080

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Abell-Howe Company.

B. Capacities and Dimensions:

1. Capacity: 2000 pounds.

2. Dimensions:

a. Span : 12 feet.

b. Height under beam: 10 feet

c. Footing: 6 feet x 6 feet x 4 feet

3. Swing: 180 degrees, maximum.

C. Features and Construction:

1. Mast: Fabricated from heavy wall structural steel pipe with wall thickness sized to minimize deflection.

2. Base plate: Large diameter base plate reinforced with heavy steel gussets for continuous alignment.

3. Head section: Rigid steel plate box type with welded construction for minimum deflection between boom and mast

4. Boom: rolled steel I-beam section with long wearing tapered flange for smooth trolley travel.

5. 360 degree rotation on a tapered roller bearing providing full capacity vertical and radial thrust loading

6. Lower section of the head to revolve around the pillar on a pair of steel rollers equipped with self-aligning roller bearings

7. Stops: Crane shall be equipped with stops to prevent any portion of the boom, hoist, or tagline system from coming in contact with building walls or structure. Verify placement of stops in the field.

D. Finish: Durable enamel in manufacturer's standard color.

2.3 CRANE, PORTABLE
Equipment Mark Number: 5280

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Star Machine and Tool Company

B. Capacities and Dimensions:

1. Boom capacity:

a. Retracted: 4000 pounds.

b. Extended: 3000 pounds.

2. Maximum boom height:

a. Retracted: 109 inches.

b. Extended: 117 inches.

3. Effective boom reach:

a. Retracted: 45 inches.

b. Extended: 60 inches.

4. Minimum overall dimensions:

a. Width: 46 inches.

b. Depth: 77 inches.

c. Height: 80 inches.

5. Leg throat: 40 inches.

6. Wheel diameters:

a. Fixed: 8 inches.

b. Leg, swivel: 8 inches.

7. Lift chain: 48 inches.

C. Features and Construction:

1. Construction: Frame and boom shall be continuously welded seam box construction of heavy steel. Legs shall be flanged, I-beam construction.

2. Adjustment: Crane boom height and length shall be adjustable without use of tools.

3. Portability: Crane assembly shall be mobile frame mounted for portability. A steerable caster shall be at mast end with handle for towing and positioning. Heavy non-steel support wheels shall be for load bearing and quiet operation.

4. Hydraulics: Manual, double acting pump shall be included for rapid boom positioning and high force multiplication lifting.

5. Lift chain: Length shall be adjustable at boom attachment. Chain shall be provided with slip hook and grab hook.

6. Operating controls: Control valve for precise lowering control with automatic valving shall limit descent speed under load.

D. Finish: Durable enamel in manufacturer's standard color.

2.4 HOIST, CHAIN, ELECTRIC
Equipment Mark Number: 5362

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Coffing Hoists

B. Capacities and Dimensions:

1. Hoist:

a. Capacity: 2000 pounds.

b. Lifting range: 20 feet.

c. Number of Chains: 2

d. Lifting speed: 8 FPM.

e. Motor: 1/2 HP.

C. Features and Construction:

1. Frame and wheels: Cast aluminum alloy with cast iron wheels and sealed, lifetime lubricated ball bearings. Motorized trolley wheels to be heat treated for added durability.

2. Five-pocket load sheave.

3. Multiple disk motor brake- heavy duty, direct acting designed for positive load spotting and holding

4. Mechanical load brake- Weston type, controls load lowering and prevents load drift. Holds independent of multiple disc motor brake

5. Load hook and chain: Forged steel hook with safety clip attached to heat treated chain by bearing type swivels.

6. Limit switches- adjustable to regulate upper and lower load travel. Provide stainless steel limit switch shaft.

7. Provide solid state starting switch

8. Gearing and transmission- helical gearing precision machined of alloy steel in oil bath.

9. Provide with overload clutch to protect hoist, clutch, and supporting structures from damaging overloads, chain jamming, and reverse phasing.

10. Wrap-around side plates to act as safety lugs and bumpers to protect wheels.

11. Hoist mounting: Lug mounted to trolley for minimum headroom.

12. Pendant: Designed to accommodate thumb or two handed operation constructed of glass- filled nylon, NEMA 3R. Control pendant shall be mounted 36 inches above finished floor.

13. Built in compliance with ASME/ANSI B30.16 and CSSA standards.

D. Controls: Pushbutton pendant, 24 volt, with cord strain relief bushings for hoist UP/DOWN.

E. Utilities Available: 208 VAC, 3 phase, 1/2 HP.

PART 3 - EXECUTION

3.1 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.

B. Inspect delivered equipment for damage from shipping and exposure to weather.

C. Compare delivered equipment with packing lists and specifications to assure receipt of all items.

3.2 INSTALLATION

A. Perform work under direct supervision of Foreman or Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect.

B. Install equipment in accordance with plans, shop drawings and manufacturer's instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level, plumb and at right angles to adjacent work.

2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.

3. Anchorage: Attach equipment, as directed by Architect, to prevent damage resulting from inadequate fastening. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.

4. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.3 TESTING

A. Perform tests and inspections.

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to start-up inspect, test, and adjust components, assemblies, and equipment installations, including connections, check operation of the equipment and components for operation and performance as specified and examine the finish for damage. Provide report in writing that the installation meets the requirements and shall include information concerning minor adjustments and minor repairs, which may be required before final acceptance by the Owner.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment

B. Prepare test and inspection reports

B. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with all specified features in the presence of the Architect using acceptance procedures provided by the manufacturer.

3.4 CLEANUP

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing or installation debris from job site.

D. Notify Architect for acceptance inspection.

3.5 TRAINING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment

B. Direct the technical representative to provide specified hours of training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.

1. CRANE, BRIDGE, FREE STANDING, 1 TON
   Equipment Mark Number: 5074
   Hours Required: 2

2. CRANE, JIB, BASE MOUNTED, 12’, 1 TON
   Equipment Mark Number: 5080
   Hours Required: 1

3. CRANE, PORTABLE, 2 TON
   Equipment Mark Number: 5280
   Hours Required: 1

4. HOIST, CHAIN, ELECT., 1 TON
   Equipment Mark Number: 5362
   Hours Required: 1

C. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

D. Provide a Windows compatible movie file format recording on DVD disk of the training session. The DVD training movie can be of a live session or a produced training video.

END OF SECTION 143000

SECTION 144500 - VEHICLE LIFTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

1.2 WORK INCLUDED

A. Equipment items as listed below by Equipment Mark Number:

1. PORTABLE LIFT
Equipment Mark Number: 5600
Submittal requirement: PD, OM, SD, T

2. LIFT, AXLE, ADJUSTABLE, 2 POST, MODULAR, 60,000 POUNDS
Equipment Mark Number: 5650
Submittal requirement: PD, OM, SD, T

3. LIFT, DRIVE-ON, WATERPROOF, PARALLELOGRAM, 50,000 LB. CAPACITY, 32 FT
Equipment Mark Number: 5703W
Submittal requirement: PD, OM, SD, T

B. Roughing-in, installation of equipment and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.

1. Coordinate and verify all electrical, foundation, and utility connections with all trades prior to equipment ordering and purchase

C. Piping, wiring, and switching between equipment and utilities.

D. The Bidder shall choose a single manufacturer for all lifts.

1.3 QUALITY ASSURANCE

A. All components shall be fully tested and documented to operate as a complete system

B. Manufacturer's Representative: The manufacturer authorized representative shall be factory trained and certified personnel providing service, startup, and quality control field labor for the project from their local office

1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out and start up.

2. Training: Provide technical representative to train Owner's maintenance personnel in operation and maintenance of specified equipment.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. Refer to above submittal requirements. The following abbreviations are used to indentify submittals required:

1. PD- Product Data

2. SD- Shop drawings

3. OM- Operation and Maintenance manual

1. T- Training of owners personnel on specific equipment items

C. Delegated-design submittal: Final design and coordination of the lift concrete foundation, rebar, pit depth, and size to accommodate each lift provided by the lift manufacturer. For equipment supports and foundations to comply with performance requirements and design criteria, including analysis data signed and sealed by a qualified professional engineer responsible for their preparation.

D. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical requirements, wiring diagrams, and provided accessories.

1. Submit Product Data in accordance with Division 1 - General Requirements of these specifications.

2. Provide installation drawings showing all interconnecting utilities such as piping and electrical requirements between controller and lift.

3. Restrict submitted material to pertinent data. For instance, do not include manufacturer's complete catalog when pertinent information is contained on a single page.

E. Shop drawings and schematics detailing fabrication, installation, piping layout, materials and finishes, system interconnections, and utility connections of equipment assemblies. Indicate dimensions, weights, loadings, foundations, final dimensions, required clearances, method of field assembly, components, and location and size of each field connection.

1.5 INFORMATION SUBMITTALS

A. Factory tests and inspection reports prior to shipping.

B. Field test and start-up reports, indicating and interpreting test results relative to compliance with specified requirements, for information.

C. Certificates: For certification required in "Quality Assurance" Article

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For the equipment identified to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For bus wash systems specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR- CLOSEOUT DOCUMENTS.

1.5 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, function and workmanship unless otherwise noted below.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.

D. Submit warranties in accordance with Division 1 - General Requirements of these specifications.

E. Any units or parts which prove defective during the warranty period will be replaced with OEM parts and transportation prepaid.

F. All parts shall be readily available locally in the United States.

1.6 COORDINATION

A. Coordinate size and location of all foundations, pit depth, pit size, lift location, supports, piping, electrical, and controls.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid or dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Mark Number of this specification.

C. Provide equipment and materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

1.8 LABELING

A. Nameplate: Manufacturer shall securely attach in a prominent location on each major item of equipment a non-corrosive nameplate with stamped figures showing manufacturer's name, address, model number, serial number and pertinent utility or operating data.

B. A.L.I. label: Manufacturer shall securely attach the A.L.I. label of the Automotive Lift Institute.

C. Lifting capacity shall be painted with letters and numbers 3 inches high Minimum on both sides of lifting mast assembly.

D. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (U.L.), or other National Recognized Testing Laboratory (NRTL), in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant.

PART 2 – PRODUCTS

2.1 PORTABLE LIFT
Equipment Mark Number: 5600

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Rotary Lift, A Dover Industries Company.

B. Description: Surface mounted wheel engaging wireless battery operated mobile column lift. One Lifting System shall consist of four electric-hydraulic mobile columns sustaining 72,000 lb capacities and one six electric-hydraulic mobile columns sustaining 108,000 lb capacities 18,000 lbs per mobile column. Mobile columns may be added, (not exceeding 8 columns), removed, or changed out. All mobile columns shall operate synchronously from any one of the lifting units by means of a control interface. The control system shall have replaceable printed circuit boards equipped with quick-connect electrical couplers. The mobile columns shall be battery operated with a DC charging system built into each column for easy recharge and communication cable cord reel for cable management

C. Warranty: The lift system must have a 5 year parts and 1 year labor warranty

D. Capacities and Dimensions:

1. Lift capacity per column: 18,000 pounds

2. Shipping weight: 1485 pounds

3. Weight per column: 1400 pounds

4. Lifting fork length: 14 inches, forks to accommodate rim sizes 9 inches minimum and 24-1/2 inches maximum.

5. Motor: 3 kw, 24 volt minimum

6. Hydraulic tank capacity: 10.5 quarts mobile columns will require 11-1/2 quarts of fluid to fill tank, hoses, and cylinders. Bio-fluid compatible.

7. Overall dimensions:

a. Height at full lower: 102 inches

b. Height at full rise: 144-3/8 inches

c. Overall width: 45-1/2 inches

d. Overall length: 48-9/16 inches

8. Turning radius: 45 inches

9. Rise: 70 inches

10. Lifting/lowering speeds: 78 seconds in full rise- 54 seconds to fully lowered position.

11. Control voltage: 24 volts DC. Rechargeable by 110 volt automatic weather tight marine charger.

12. Battery charge cycle (new battery): 15-20 cycles per charge at rated load of lift

E. Features and Construction:

1. Column Assemblies:

a. Columns shall be constructed of formed channel fabrication from a single steel plate and shall not require welded seams to form the column structure.

b. Columns shall be further reinforced externally along their back face with structural steel angle for additional rigidity and extended service life. Rigid column design shall be protected from corrosion via sand blasted enamel painting of metal surfaces.

c. Each column shall be fabricated to a set of legs that will sit directly on the floor and provide a stable platform when lifting a load. When unloaded the mobile columns ride on a set of wheels to allow the units to be moved. When a vehicle is lifted, the wheels shall automatically retract and the lift shall sit down flat on its steel base and no lifted weight shall remain on the casters. Legs have an extended fork configuration that allows for extensions to be added at any time. Such extensions will permit the addition of longer forks to lift dual wheel assemblies or optional assemblies for lifting vehicles further away from the column assembly.

d. Each of the lifting units shall contain a mechanical locking latch mechanism completely separate from the drive of lifting system. This lock shall be gravity actuated with a spring loaded assist to ensure engagement at any position. Spacing between locking positions shall be a maximum of 3 inches (76 mm) in accordance with ALCTV-2006.

e. The column structures shall be easily moveable on three wheels consisting of two fixed heavy duty steel wheels and a dual rubber steering wheel mounted at the rear of the column. Columns shall come equipped with a

hoisting hook for lifting by overhead crane and a fork lift pocket lifting points on each column for ease of relocation by standard fork lift

2. Carriage Assemblies:

   a. Each column assembly shall include a carriage assembly which consists of 4 Ultra High Molecular Weight (UHMW) roller bearings. These bearings shall be oil impregnated and shall not require any greasing or maintenance of any kind.

   b. Each carriage assembly shall include a full enclosure for the lifting cylinder chrome rod. No part of the chrome lifting cylinder shall be exposed to impact at any time during the lifting stroke.

   c. Forks shall provide a minimum of 12 inches of sufficient safety clearance between column and body of vehicle. Forks shall also be available in an extended configuration capable of supporting inboard tires on dual-wheeled axles.

   d. Carriage assemblies shall come equipped with adjustable lifting forks to allow for adjustment of lifting forks for small tire applications to standard large tire applications without need for adapter sleeves. Forks shall include handles to facilitate the lateral adjustment of forks for narrower and wider tires. Adjustment shall be accomplished by release of a spring loaded lock on the top of the fork. When adjustment of the forks is complete, locks shall automatically re-engage to secure forks from further movement

3. Hydraulic System:

   a. Each lifting unit shall be equipped with an electric hydraulic power unit, consisting of a DC motor, gear pump, reservoir, check valve, pressure relief valve, and two control valves. Entire power unit totally enclosed to protect from dirt and water.

   b. The direct drive lifting cylinder shall be installed in such a manner as to push the carriage up, using no chains or cables. The extension of the cylinder shall occur inside of the carriage as to keep the plunger of the cylinder protected from dirt, sand, or any possible mechanical damage.

   c. Hydraulic check valve shall hold load at any position of the cylinder. Redundant mechanical safety lock shall be continuously engaged except while lift is being lowered.

   d. Solid zinc plated steel pipes are used to circulate all hydraulic fluids in the system.

   e. Pressure relief valve shall prevent overloading of the lifting unit.

f. Unit shall be equipped with two control valves that shall be used to maintain synchronous operation when a lifting system of more than one column is being commanded to raise or lower.

g. Hydraulic system is self-lubricating and shall require little to no maintenance.

h. A velocity fuse shall be installed directly to the end of the cylinder in order to keep hydraulic fluids from discharging if there is a fast leak somewhere after the cylinder, which could cause the load to unintentionally be lowered.

4. Control System: Premium, wireless system.

a. Lifts to be capable of going from wireless to wired communications with a flip of a switch.

b. All mobile columns shall have identical control panels and shall be designed to be interchangeable without regard to master/slave relationships.

c. All mobile control panels are waterproof NEMA Type 4.

d. All control circuits and motor power supply circuits shall be 24 volts.

e. Circuit boards are upgradeable. Upgrades in software or control programming shall be available by swapping a memory stick only and board replacement or reprogramming by the user shall not be necessary. All mobile columns shall have a manual lowering override due to lose of power to the unit.

f. All mobile columns shall have a manual lowering override due to lose of power to the unit.

g. Indication lights on each control panel shall show mobile column configurations for an individual mobile column, paired mobile columns, grouped mobile columns, or all mobile columns.

h. “UP” and “Down” buttons shall have momentary function “Dead Man” type switches while depressed and operate from only one control panel at a time.

i. “Select” button shall permit operation of an individual mobile column, paired mobile columns, grouped mobile columns, or all mobile columns.

j. “Emergency Stop Button” on each panel will shut down all connected mobile columns.

k. All control panels have automatic synchronization through the full stoke of the hydraulic cylinder with a maximum tolerance of 1 inch.

l. Control system will actively control hydraulic correction to maintain level synchronization, unless a column deviates more than 3.5 inches from any other column, at which point all motion halts and an error alert is generated.

m. Error codes and other diagnostic information is automatically provided when a fault is detected via alpha-numeric display.

n. Programmable height limit settings with no external limit switches.

o. Communication cables shall connect from one column to the next in any order in a single loop forming a horse shoe pattern allowing ingress and egress into the mobile columns without driving over cables. Connecting cables are 50 feet (15240mm).

p. Lift shall come equipped with a lower to lock function.

q. Lift shall come equipped with a slow lowering function.

r. Each column shall have its own 110 volt waterproof marine, twenty (20) amps, 2 -bank battery smart-charger. The battery charger shall have two independent 12 VDC output leads and incorporate automatic 3-stage charging to minimize charge time and maximize battery life. Total recovery time for a completely discharged system is less than 12 hours. All battery chargers in a system can be connected together into a single 110V receptacle.

s. The lift control interfaces shall include visual representations showing the relationships between the lift columns and a vehicle, such as lift column icons positioned around a vehicle icon.

t. Lift shall come equipped with a three color battery charge indicator. The charger shall also indicate the status of the battery.

u. Each column shall be equipped with a 50 foot cord reel for communications cord management. Reels shall be mounted 7 feet (2134mm) above floor level and shall be festooned above each column to permit unrestricted access. It shall not be necessary for cords to lay on the floor.

v. Custom features as indicated on Drawings.

w. System set up must be accomplished in a single trip set up around columns to minimize set up time and user confusion, direction and operation will not matter

5. Steering:

a. The steering assembly shall consist of a fully automatic, spring-loaded steering handle. The steering handle shall lock the movement of the rear wheel when it is in the vertical position.

b. The steering assembly shall allow the lift to be moved around the shop floor without the need to pump up a hydraulic jack or pallet jack mechanism.

c. The rear wheel shall be spring loaded as to retract when weight is applied to the column. All other wheels will automatically retract when the lift is loaded with the weight of a vehicle. All wheels shall be equipped with sealed ball bearings.

6. Lift shall be 3rd party certified by ETL testing laboratory and labeled with the ETL/Automotive Lift Institute (ALI) label that affirms the lifts meet conformance to all applicable provisions of American National Standard ANSI/ALI ALCTV-2006 and in compliance with IBC 2003, IBC 2006 chapter 30 section 3001.2

2.2 LIFT, AXLE, ADJUSTABLE, 2 POST, MODULAR, 60,000 POUNDS
Equipment Mark Number: 5650

B. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Rotary Lift, A Dover Industries Company

B. Description: Lift shall consist of two individual lifting assemblies in line with the longitudinal axis of the vehicle, each lifting assembly so equipped as to engage the axle, suspension, as specified herein. One of the two lifting cylinder assemblies will be movable along this same axis to affect variable spacing between the lifting cylinder assemblies. The front movable unit will herein after be referred to as the "front post modular" and the stationary unit will be referred to as the "rear post modular."

C. Warranty: The lift system must have a 5 year parts and 1 year labor warranty

D. Capacities and Dimensions:

1. Lift capacities:

a. Front: 30,000 pounds.

b. Rear: 30,000 pounds.

c. Total: 60,000 pounds.

2. Lift rise:

a. Front: 70 inches

b. Rear: 70 inches.

3. Plunger diameter, telescoping:

a. Front:

1) First stage: 9-3/8 inches.

2) Second stage: 8-1/8 inches.

b. Rear:

1) First stage: 9-3/8 inches.

2) Second stage: 8-1/8 inches.

4. Maximum wheelbase: 306 inches.

5. Minimum wheelbase: 120 inches.

6. Frame length: 24 feet.

7. Center of rear jack to rear of front track: 60 inches.

8. Adapter adjustment range:

a. Front adapter: 40-1/4 inches minimum, 57-3/4 inches maximum.

b. Rear adapter: 33 inches minimum, 47 inches maximum.

9. Electro-Hydraulic power unit:

a. Motors:

1) Post drive: 5 HP, explosion proof motor, one each per post (10 HP total).

2) Wheelbase adjustment: 2 HP, explosion proof motor and chain assembly, one each.

b. Hydraulic fluid displacement: 20 gallons.

c. Overall dimensions:

1) Width: 42 inches.

2) Depth: 14 inches.

3) Height: 67 inches.

E. Features and Constructions:

1. General: Lifting Units Lift shall consist of two individual modular lifting assemblies in line with the longitudinal axis of the vehicle, each lifting assembly so equipped as to engage the axle, suspension, as specified herein. Each modular lifting assembly shall be housed in a totally contained environmentally safe housing. The movable post shall be equipped with automatic shutter-plate covers that move with the post so as to keep the trench opening covered at all times. All trench cover plates, including recess covers shall be permanently attached to the

floor openings to insure their proper use. The modular lifting system shall be VEC equalized and controlled. The operation of the lift shall be electro hydraulic.

2. Front post modular:

a. Movable post: The front movable post shall be equipped with a carriage assembly with permanently lubricated bearing wheels for smooth movement in the structural channel track. The casing of the movable post shall be coated with polyurethane coating of ¼ inch thickness with an electrolyte value of 37,500 volts minimum coating for ultimate durability and maximum protection against deterioration due to electrolysis and/or harsh contaminates for ultimate durability and maximum protection against deterioration due to electrolysis and/or harsh contaminates. The coating shall keep oil contained in the housing and shall keep ground water from penetrating the exterior of the housing.

b. Recessed track: Recessed track sized to allow movable post to engage wheelbases specified. The track shall have a pocket location to house the saddle and adapter assembly when lift is in the lowered position providing and unobstructed clear floor. The recess shall allow the superstructure and adapters to be stored completely below grade. When lowered, no part of the saddle or its adapters shall interfere with the drive thru clearance of the bay. It shall not be necessary to remove adapters to achieve full ground clearance and it shall not be required to remove or reposition the adapters in order to close the pit covers. All openings in the floor and gaps between floor and superstructure must be covered when the lift is down.

c. Wheelbase adjustment: Wheelbase adjustment shall be accomplished by an explosion proof electric motor and chain drive assembly. The motor shall be located in the front post modular housing on the vertical panel nearest the rear post modular housing. Adjustment control shall be located on the control console.

d. Lift locks: The lift lock shall be rated at same capacity as the corresponding jacking unit. The lock leg shall be a two stage telescoping type constructed of rectangular tubing. The lock leg shall be equipped with 18 locking positions on 3 inch increments. The locking latch shall be spring loaded to the lock position and shall be released at the control console. The locking latch shall be gravity activated with a spring loaded assist. Release mechanism shall be an air cylinder. Hydraulically operated or electrically operated safeties are not acceptable. The lift locking leg shall be attached to the saddle to prevent rotation ensuring proper location of releases at all times. The locking leg shall prevent rotation of the piston assembly.

e. Electro-Hydraulic Power Unit: The front modular unit shall be equipped with a 20 gallon power unit assembly, with an explosion proof motor.

The power unit system shall supply ample pressure for operation of lift system. The power unit shall be housed within the modular housing.

f. Modular Containment: The modular containment shall be a steel enclosure 5'-7" in depth, appropriately sized in length to accommodate specified wheelbase range. The containment shall be coated internally and externally with polyurethane coating of ¼ inch thickness with an electrolyte value of 37,500 volts minimum coating for ultimate durability and maximum protection against deterioration due to electrolysis and/or harsh contaminates. The coating shall be applied to the inside and the outside of the containment housing to create a ½" thick impermeable shell that is watertight, encapsulated against corrosion and electrolysis. The unit shall be tested against electrolysis by way of a volt stray current test. The containment shall be designed to prevent the release of any contaminants in to the surrounding soil or infiltration by hydrostatic pressure from surrounding water tables. The Containment shall be equipped with a Liquid Detection System that shall relay visual notification to the lift control LCD screen upon detection of 5 inches of liquid accumulation in the containment. The containment shall be equipped with a fitting located on a floor cover plate connected to a 1 ½" PVC tube routed to the bottom of the containment, which permits the removal of any liquid accumulation from the surface level

3. Rear Post Modular:

a. Rear stationary post: The rear stationary post shall be of the same design construction, diameter and rise as the front post.

b. Rear Frame: The rear frame unit will provide an integral wheel spotting dish at floor level in order to accurately locate vehicle axles over the lifting saddle and adapters and shall be embedded below grade on both sides of the rear module. No part of the wheel spotting system shall protrude above the floor surface and the spotting adapters shall be provided on both sides of the module to allow loading by the operator either in forward or reverse gear. The frame assembly shall also provide a recess beneath the floor for the rear saddle and base adapters when the plunger is in the down position. The recess shall allow the superstructure and adapters to be stored completely below grade. The recess area shall be 48 inches wide and have cover doors to close over the opening when lift is not in use. When lowered, no part of the saddle or its adapters shall interfere with the drive thru clearance of the bay. It shall not be necessary to remove adapters to achieve full ground clearance and it shall not be required to remove or reposition the adapters in order to close the pit covers.

c. Lift locks: The lift locks shall be of the same design and construction as the front post.

d. Power unit: The power unit shall be of the same construction and design as the front post.

e. Modular housing: The modular housing shall be a steel enclosure 6 feet in depth, appropriately sized to house the stationary post assembly and power unit. The housing shall be coated internally and externally with a polyurethane coating with an electrolyte value of 37,500 volts minimum for durability and protection against deterioration due to electrolysis and/or harsh contaminates. The housing shall be designed to preventing the release of any contaminants into the surrounding soil.

4. Controls (equipment mark number: 5651) : The variable equalized control system shall be in a surface mounted console 4 feet, 3-7/32 inches high by 2 feet wide and shall rest on a 3 inch high concrete service pad. The variable equalized control system shall allow individual or simultaneously control of the lifting assemblies and infinite speed adjustment from stopped to full for all operations. The control shall include the following features and functions.

a. The control panel shall be equipped with a joystick type control for fore/aft movement of the front movable post and up/down operation of each lifting assembly. The joystick control shall be equipped with a locking ring to prevent accidental engagement of the control when not in use. The joystick shall permit fine adjustment of the lifting carriage or moveable piston to permit accurate alignment of axles, unloading of wheels, and reinstallation of drive-train components.

b. The equalization shall monitor all lift assemblies in relation to each other. The equalization shall be accomplished through variable motor rotation without the use of flow metering valves.

c. The lift control panel shall be equipped with technology allowing system communication through the use of an LCD Screen. The LCD screen shall provide onboard: Operation Training, Operation Manual, Preventative Maintenance Reminders, Fault Codes, and Site Specific Presets.

d. The system shall provide the ability for the following facility required settings:

1) Up to (10) memorized wheelbase locations as required by fleet.

2) Up to (4) memorized height requirements as required by facility.

3) The control system shall indicate to the operator when the lift is fully lowered to prevent damage to the vehicle, the lift and to eliminate tire damage.

4) The control system shall indicate to the operator which lifting pistons are activated, when the moveable piston is moving fore and aft, when the moveable post is in its ”home” position and when each piston is fully recessed below grade

e. The control system shall be compliant with the requirements of ANSI, ALI, UL201 and all other applicable NEC requirements.

f. Provide 2 inch PVC under slab to connect control panel to power pad.

g. Provide 2 inch PVC under slab to accommodated compressed air connection from controller to lift. Underslab compressed air piping to be rubber flexible tubing designed for compressed air and rated to comply with lift manufacturer's pressure requirements. Tubing to be routed in PVC to accommodate accessible maintenance.

h. Control voltage to be 24V. Controller to be provided with 460V to 24V transformer.

F. Accessories:

1. Liquid evacuation kit: Air operated pump to evacuate any liquid within the lift pit. Pump to be attached to splash shield in the stationary housing using supplied brackets and hardware. Kit package to include the following features:

a. Pump:

1) Air operated, non metallic, double diaphragm pump.

2) Capacity: 72 gpm and 68 ft head pressure at 30 feet net positive suction head and 100 psi inlet operating pressure.

3) Air valve: no-lube

4) Solids valve: up to .47 inches

5) ISO9001 and ISO14001 Certified

b. All air tubing to and from pump and PVC pipe assembly to drain pit.

c. Entry boots

d. Controls integrated into lift control council.

2. Provide all required electrical conduit, wiring, and compressed air tubing required.

G. Finish: Manufacturer's standard finish in manufacturer's standard colors.

H. Utilities Available:

1. Electric: 480 VAC, 3 phase, 12 HP total.

2. Air: 125 PSI.

2.01 LIFT, DRIVE-ON, WATERPROOF PARALLELOGRAM, 50,000 LB. CAPACITY, 32 FT
Equipment Mark Number: 5707W

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide equipment by Rotary Lift, A Dover Industries Company

B. General:

1. Description: The vehicle lift shall be a heavy duty, recessed mounted parallelogram drive-on type powered by a remote electric hydraulic power and control unit. The lifting mechanisms shall be fully concealed under the track when lowered, and there shall be no in-ground or above ground posts or columns required. All lift components shall be suitable for use in a wet environment.

2. Components: The lift shall be an integrated system for lifting vehicles within the specified weight and dimensional ranges and shall comply with all applicable Federal, State, and local safety regulations and codes as well as OSHA, UL, AWS, NEC, and ANSI-B153.1 Standards. Components shall be as follows:

a. Lift unit: The lift unit shall include a platform, composed of two separate and independent runways, each attached to hydraulically operated lifting legs with built-in mechanical locking system. Lifting legs shall be securely attached to the slab with anchor bolts.

1) Each lifting leg shall be attached to a base plate with welded support bracket for the cylinder attach pin. The base plates shall be 22 by 28 inches and of sufficient thickness to support the designed load.

2) There shall be no fixed obstructions between the platform runways.

3) There shall be no floor obstructions between the lifting legs.

b. Control console: A separate control console shall house the hydraulic fluid reservoir, pump and motor, lift operating controls, and air supply for the locking legs.

c. Interconnections: All required steel reinforced hydraulic hose or stainless steel piping, nylon compressed air supply line, and electrical cabling with necessary couplings or connections shall be provided to connect the control console with the lift unit.

d. Replacement components: Replacement components must be locally available to minimize down time.

3. Warranty: The lift system must have a 5 year parts and 1 year labor warranty.

4. Structural and utility requirements: The structural and utility requirements shown in the bid documents are based on the lift as manufactured by the Prime Manufacturer. The Contractor is responsible for coordinating all structural, mechanical, electrical, and plumbing requirements with the lift manufacturer prior to beginning installation.

C. Capacities and Dimensions:

1. Capacity: 50,000 pounds.

2. Platform dimensions:

a. Runway width: 30 inches, minimum.

b. Runway length: 384 inches, nominal.

3. Spacing between runways: 45 inches.

4. Overall length: 384 inches nominal.

5. Overall width: 109 inches, minimum.

6. Collapsed height: 0 inches.

7. Raised platform height: 63 inches, minimum above finished floor.

8. Platform lock stops: 13 stops, minimum.

9. Hydraulic cylinders:

a. Number of cylinders: Six total (Three per runway).

b. Cylinder diameter: 6 inches.

10. Rate of rise: 50 inches per minute, minimum.

11. Horizontal movement (from collapsed to fully raised position): 54 inches, nominal.

12. Power and control console:

a. Width: 30 inches, nominal.

b. Depth: 27 inches, nominal.

c. Height: 36 inches, nominal.

d. Reservoir capacity: 25 gallons, nominal.

e. Pump motor size: 20 HP, minimum.

D. Features and Construction:

1. General:

a. Location of equipment: Sufficient lengths of hydraulic pipe, air line, and electrical cable shall be supplied to interconnect the power and control console through Contractor provided PVC pipe chases to the lift unit.

b. Non-skid coating: Lift platforms shall have a non-skid coating applied to upper surface.

c. The lift members shall have marine grade paint, designed for a wash bay environment, and applied throughout.

2. Lift unit: The lift unit shall be composed of two runways each with four lifting legs.

a. Lifting legs: Each platform runway shall incorporate four lifting legs with integral locking mechanisms.

b. Platform runways: Runways shall be constructed of 375 inch thick minimum steel plate supported by .25 inch thick minimum steel beams designed to withstand projected loads. The lifting platforms upper surface shall have an epoxy coal tar overlay membrane of industrial grade non-skid material that is applied under strict quality control parameters to ensure proper adhesion to the substrate.

c. Wheel chocks: Each runway shall have steel wheel chocks mounted at each end to prevent a vehicle from being drive off the lift that automatically pivot into place when the runway is raised and recede when the runway is lowered.

d. Base Plates: Each Base plate shall be fabricated from stainless steel with stainless steel anchors for use in a wet environment.

3. Leveling and anchoring provisions:

a. Base: The base of each lifting leg shall provide for a minimum of 1 inch vertical adjustment by means of grade 8 (minimum) adjusting bolts with lock nuts to allow for field adjustment in the event of floor slab shifting or settling.

b. Mounting bolt holes: The base of each lifting leg shall have 12 pre-drilled holes to accept 1-1/4 inch anchoring bolts which shall be installed with a minimum embedment of 5.50 inches in the floor slab.

c. Grout: The base of each lifting leg and mounted bolts shall be grouted to prevent corrosion.

4. Hydraulic system:

   a. Hydraulic cylinders: Hydraulic cylinders shall be mounted to the underside of each runway and attached to the runway and to the lifting leg. Each cylinder shall have an integral flow check to prevent collapse in the event of a major fluid leak. Pistons shall be stainless steel for use in wet environment.

   b. Pump: The lift shall be driven by a hydraulic gear pump capable of supplying the appropriate pressure and flow rate to operate the lift safely.

   c. Hydraulic hoses: All hydraulic hoses shall be of steel reinforced construction and have standard JIC fittings throughout

   d. Manual operation: The lift shall be able to be lowered from any raised position by operation of a manual pump and valving.

5. Safety locks:

   a. Quantity: One set of steel safety locks, with a safety factor of not less than 3 to 1, shall be mounted to each lifting leg and cylinder and shall allow the lift to be locked at a minimum of 10 different levels. These locks shall ensure a minimum amount of travel in the event of a hydraulic fluid leak and shall maintain the height of the lift in that situation.

   b. The lift shall have full length continuous safety tapeswitch mounted to the lower surface of the main lifting platform. Safety tapeswitch will be located on the inside and outside of both platforms. When any of these tapeswitch are displaced horizontally or vertically, the lift will stop

   c. Capacity: Safety locks shall be capable of supporting the rated load of the lifting leg without assistance of the hydraulic cylinder, allowing the cylinders to be removed while the lift is elevated and under load.

   d. Operation: Safety locks shall automatically disengage when the lift LOWER control is operated, and automatically re-engage when the lift LOWER control is released. Safety locks shall be automatically engaged when the lift ascends.

6. Safety bars: The lift shall be equipped with full length, continuous safety bars mounted to the inside and outside edge of each runway. When any bar is displaced horizontally or vertically the lift will stop and lock out controls until the condition is corrected.

E. Operating Controls(equipment mark number 5704W): Operating controls shall be capable of synchronizing elevations with a height difference not to exceed 2 inches, during both raising and lowering operations with the most adverse rated load placed on the lift. If height difference exceeds 2 inches the lift shall stop and lockout the operator until unsafe condition is corrected. The control system shall not rely upon mechanical links to synchronize the runways.

1. Console: Controls shall be mounted in a remote power and control console. Cables, interconnecting cabling, and piping shall be installed in PVC pipe chases in the slab provided by the Contractor. The control system shall be encased in Enviroguard coating. The coating must be a 1/8” thick polyurethane coating with an electrolytic value of 37,500 volts minimum. The coating must completely cover the entire outside and the bottom 18” of the inside of the control panel to protect the metal surface against corrosion. This coating must be factory applied under proper quality control procedures and testing to insure conformance.

2. Control console shall house the following equipment: Oil reservoir, suction strainer, low pressure return filter, hydraulic gear pump and manual pump.

3. Construction: Console housing shall be an appropriately rated National Electrical Manufacturers Association type enclosure with control switches, buttons, and lights mounted on a sloping top.

4. Controls: Controls shall include RAISE, PRESS TO LOCK LIFT, and LOWER pushbuttons with a fusible link main disconnect switch with key lock or padlock tabs. Controls shall be dead man type, requiring constant pressure to operate.

5. Status lights: The control panel shall include lights to indicate the status of all safety related interlocks.

6. The control system shall be operated by a Programmable Logic Control (PLC) and lock-out all operations of lift controls if an unsafe condition exists due to insufficient air pressure to operate safety locks; displaced safety tapeswitch or uneven platform heights. This lock-out shall not be able to be reset unless unsafe condition has been corrected

7. Control voltage to be 24V. Controller to be provided with 460V to 24V transformer

F. Accessories:

1. Lighting system: Lifting platforms shall have cool white fluorescent lighting system consisting of five evenly spaced 40 watt, 48 inch lamps per runway (ten total) mounted in shatter-proof tubes on the inside edge of each runway. The lighting system shall automatically turn on when the lift is raised 22 inches above finished floor and turn off automatically when lift descends below 22 inches. Lighting shall be waterproofed for use in a wet environment. Lamp units shall be installed in a recessed area of the main lifting platforms to be protected from damage caused by falling objects.

2. Remote control panel to control lift separate from main control counsel, mounted to wall, suitable for use in wet environments.

3. Provide all required electrical conduit, wiring, and compressed air tubing required.

G. Power System: The lift shall include a remote electro-hydraulic power unit, complete with hydraulic fluid reservoir, hydraulic pump, motor, positive displacement flow splitter, dump valve, valve manifold, motor starter, and low voltage power transformers. The power unit shall be pre-wired to allow a single-point connection and shall be mounted with the power and control console. All power unit components shall be suitable for use in a wet environment.

H. Utilities Available:

1. Electrical:

a. Lift: 460 VAC, 3 phase, 20 HP.

b. Controls and lighting: 120 VAC, 1 phase, 17 A.

2. Air:

a. Lift: 1/4 inch, 100 PSI, 5 CFM.

I. Finish: Marine paint in manufacturer's standard colors.

PART 3 - EXECUTION

3.1 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.

B. Inspect delivered equipment for damage from shipping and exposure to weather.

C. Compare delivered equipment with packing lists and specifications to assure receipt of all items.

3.2 INSTALLATION

A. Perform work under direct supervision of Foreman or Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect.

B. Install equipment in accordance with plans, shop drawings and manufacturer's instructions:

1. Provide all additional materials required for complete installation as indicated on manufacturer’s installation drawings

2. Positioning: Place equipment in accordance with any noted special positioning requirements generally level, plumb and at right angles to adjacent work.

3. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.

4. Anchorage: Attach equipment securely to prevent damage resulting from inadequate fastenings. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.

5. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.3 TESTING

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to start-up inspect, test, and adjust components, assemblies, and equipment installations, including connections, check operation of the equipment and components for operation and performance as specified and examine the finish for damage. Provide report in writing that the installation meets the requirements and shall include information concerning minor adjustments and minor repairs, which may be required before final acceptance by the Owner.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment

B. Prepare test and inspection reports

B. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with all specified features in the presence of the Architect using acceptance procedures provided by the manufacturer

3.4 CLEANUP

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing or installation debris from job site.

D. Notify Architect for acceptance inspection.

3.5 TRAINING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment

B. Direct the technical representative to provide specified hours of training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.

1. PORTABLE LIFT
Equipment Mark Number: 5600
Hours Required: 2

2. LIFT, AXLE, ADJUSTABLE, 2 POST, MODULAR, 60,000 POUNDS
Equipment Mark Number: 5650
Hours Required: 2

3. LIFT, DRIVE-ON, WATERPROOF, PARALLELOGRAM, 50,000 LB. CAPACITY, 32 FT
Equipment Mark Number: 5707W
Hours Required: 2

C. Demonstrate lift operation utilizing each of the vehicle types operated by Owner.

D. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

E. Provide a Windows compatible movie file format recording on DVD disk of the training session. The DVD training movie can be of a live session or a produced training video.

END OF SECTION 144500

SECTION 210513 - COMMON MOTOR REQUIREMENTS FOR FIRE SUPPRESSION EQUIPMENT

PART 1 – GENERAL

1. 1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

B. RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k- 4(d) (13):

2 The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.4 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 – PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

1. Comply with NEMA MG 1 unless otherwise indicated.
2. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation:

J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features

coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 210513

SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 – GENERAL

1. 1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve
3. Sleeve-seal
4. Sleeve-seal fittings.
5. Grout.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d)(13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

PART 2 – PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
3. Wade Division / Tyler Pipe

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Products & Systems, Inc.
2. Metraflex Company (The).
3. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Presealed Systems.
2. Advance Products & Systems, Inc.
3. Metraflex Company (The).

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 – EXECUTION

3. 1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or –PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at

pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3. 5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls below Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

2. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs above Grade:

a. Piping Smaller than NPS 6 Galvanized-steel-pipe sleeves.

b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.

4. Interior Partitions:

a. Piping Smaller Than NPS 6: PVC-pipe sleeves.

b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 210517

SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Related Requirements

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(d) (13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

PART 2 – PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-

clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1 Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast- brass or split-casting brass type with polished, chrome-plated finish.

e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

h. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 210518

SECTION 210523 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d) (13):

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 SUMMARY

A. Section Includes:

1. Two-piece ball valves with indicators.
2. Bronze butterfly valves with indicators.
3. Iron butterfly valves with indicators.
4. Check valves.
5. Bronze OS&Y gate valves.
6. Iron OS&Y gate valves.
7. NRS gate valves.
8. Indicator posts.
9. Trim and drain valves.

B. RELATED SECTIONS

1.3 DEFINITIONS

A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

B. NRS: Nonrising stem.

C. OS&Y: Outside screw and yoke.

D. SBR: Styrene-butadiene rubber.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.

1. Protect threads, flange faces, and weld ends.

2. Set valves open to minimize exposure of functional surfaces

B. Use the following precautions during storage:

1. Maintain valve end protection.

2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

D. Protect flanges and specialties from moisture and dirt.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:

1. Main Level: HAMV - Fire Main Equipment.

a. Level 1: HCBZ - Indicator Posts, Gate Valve.

b. Level 1: HLOT - Valves.

1. Level 3: HLUG - Ball Valves, System Control.

2. Level 3: HLXS - Butterfly Valves.

3. Level 3: HMER - Check Valves.

4. Level 3: HMRZ - Gate Valves.

2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.

a. Level 1: VQGU - Valves, Trim and Drain.

B FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:

1. Automated Sprinkler Systems:

a. Indicator posts.

b. Valves.

1) Gate valves.

2) Check valves.

a) Single check valves.

3) Miscellaneous valves.

C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.

D. ASME Compliance:

1. ASME B16.1 for flanges on iron valves.
2. ASME B1.20.1 for threads for threaded-end valves.
3. ASME B31.9 for building services piping valves.

E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

F. NFPA Compliance: Comply with NFPA 24 for valves.

G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.

H. Valve Sizes: Same as upstream piping unless otherwise indicated.

I. Valve Actuator Types:

1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
2. Handwheel: For other than quarter-turn trim and drain valves.
3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.2 TWO-PIECE BALL VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. NIBCO INC.
2. Anvil International, Inc.
3. Victaulic Company.

B. Description:

1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
2. Minimum Pressure Rating: 175 psig.
3. Body Design: Two piece.
4. Body Material: Forged brass or bronze.
5. Port Size: Full or standard.
6. Seats: PTFE.
7. Stem: Bronze or stainless steel.
8. Ball: Chrome-plated brass.

9. Actuator: Worm gear or traveling nut.
10. Supervisory Switch: Internal or external.
11. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
12. End Connections for Valves NPS 2-1/2: Grooved ends.

2.3 IRON BUTTERFLY VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Anvil International, Inc.
2. Tyco Fire & Building Products LP.
3. Victaulic Company.

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, nickel plated and EPDM or SBR coated.
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Body Design: Grooved-end connections.

2.4 CHECK VALVES

A Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Anvil International, Inc.
2. Victaulic Company.
3. Viking Corporation.

B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.

8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.5 IRON OS&Y GATE VALVES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Victaulic Company.
2. NIBCO INC
3. Clow Valve Company; a division of McWane, Inc.

B. Description:
1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Grooved.

2.6 NRS GATE VALVES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Victaulic Company.
2. NIBCO INC.
3. Clow Valve Company; a division of McWane, Inc.

B. Description:
1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.

8. Supervisory Switch: External.
9. End Connections: Grooved.

2.7 INDICATOR POSTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Mueller Co.; Water Products Division.
2. Clow Valve Company; a division of McWane, Inc.
3. Kennedy Valve; a division of McWane, Inc.

B. Description:
1. Standard: UL 789 and FM Global standard for indicator posts.
2. Type: Underground.
3. Base Barrel Material: Cast or ductile iron.
4. Extension Barrel: Cast or ductile iron.
5. Cap: Cast or ductile iron.
6. Operation: Wrench.

2. 8 TRIM AND DRAIN VALVES

A. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Conbraco Industries, Inc.; Apollo
   b. NIBCO INC.
   c. Potter Roemer.
2. Description:
   b. Pressure Rating: 175 psig
   c. Body Design: Two piece.
   c. Body Material: Forged brass or bronze.
   d. Port size: Full or standard.
   e. Seats: PTFE.
   f. Stem: Bronze or stainless steel.
   g. Ball: Chrome-plated brass.
   h. Actuator: Handlever.
   i. End Connections for Valves NPS 1 through NPS 2- Threaded ends
   j. End Connections for Valves NPS 1-1/4 and NPS 2- Grooved ends.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fire Protection Products, Inc.
   b. NIBCO INC.
   c. United Brass Works, Inc.

2. Description:

   a. Pressure Rating: 175 psig .
   b. Body Material: Brass or bronze.
   c. Ends: Threaded.
   d. Stem: Bronze.
   e. Disc: Bronze.
   f. Packing: Asbestos free.
   g. Handwheel: Malleable iron, bronze, or

C. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. NIBCO INC.
   b. United Brass Works, Inc.
   c. Conbraco Industries, Inc.; Apollo Valves
2. Description:
   a. Pressure Rating: 175 psig.
   b. Body Material: Bronze with integral seat and screw-in
   c. Ends: Threaded.
   d. Stem: Bronze.
   e. Disc Holder and Nut: Bronze.
   f. Disc Seat: Nitrile.
   g. Packing: Asbestos free.
   h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

A. Comply with requirements in the following Sections for specific valve installation requirements and applications:

1. Section 211200 "Fire-Suppression Standpipes" for application of valves in fire- suppression standpipes.
2. Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.
3. Section 211316 "Dry-Pipe Sprinkler Systems" for application of valves in dry-pipe, fire-suppression sprinkler systems.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above the pipe center.

F. Install valves in position to allow full stem movement.

G. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

H. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.

I. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

END OF SECTION 210523

SECTION 210548.13 - VIBRATION CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

1. GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Pipe-riser resilient supports.
5. Resilient pipe guides.
6. Elastomeric hangers.

B. Related Requirements:

1. Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment" for devices for plumbing equipment and systems.
2. Section 230548.13 "Vibration Controls for HVAC" for devices for HVAC equipment and systems.

C. Related Sections

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k- 4(d) (13):
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components, and profiles, and finishes.
2. Include rated load, rated deflection, and overload capacity for each vibration isolation

device.

3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

C. Delegated-Design Submittal: For each vibration isolation device.

1. Include design calculations for selecting vibration isolators.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation for fire-suppression piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For testing agency.

C. Welding certificates.

1.5 QUALITY ASSURANCE SUBMITTALS

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

2. PRODUCTS

2.1 PIPE-RISER RESILIENT SUPPORTS

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- thick neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.

2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.2 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- thick neoprene.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.3 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Kinetics Noise Control, Inc.
b. Mason Industries, Inc.
c. Vibration Eliminator Co., Inc.

2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.

3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

3. EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION CONTROL DEVICE INSTALLATION

A Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

END OF SECTION 210548.13

SECTION 210548 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe-riser resilient supports.
2. Resilient pipe guides.
3. Elastomeric hangers.
4. Snubbers.
5. Restraint channel bracings.
6. Seismic-restraint accessories.
7. Mechanical anchor bolts.
8. Adhesive anchor bolts.

B. Related Requirements:

1. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for devices for plumbing equipment and systems.

C. RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k- 4(d) (13):
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning & Development (for the State of Connecticut).

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO

CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction.
   b. Annotate to indicate application of each product submitted and compliance with requirements.
4. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.

1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified State of CT professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
4. Seismic-Restraint Details:
   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacing. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

d. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for fire-suppression piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified State of CT professional engineer.

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: D.

2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.
    a. Component Importance Factor: 1.0**.**
    b. Component Response Modification Factor: 1.5.
    c. Component Amplification Factor**:** 2.5.
3. Design Spectral Response Acceleration at Short Periods: See drawing S100.
4. Design Spectral Response Acceleration: See drawing S100**.**
5. Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
    a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

2.2 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- thick neoprene.
    1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
    2. Maximum Load Per Support: 500 psigon isolation material providing equal isolation in all directions.

2.3 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post-and-sleeve arrangement separated by a minimum 1/2-inch- thick neoprene.
    1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.4 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
    1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
        a. Kinetics Noise Control, Inc.
        b. Mason Industries, Inc.
        c. Vibration Eliminator Co., Inc.

    2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an

opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.

A. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.5 SNUBBERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Kinetics Noise Control, Inc.
2. Mason Industries, Inc.
3. Vibration Mountings & Controls, Inc.

B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

2.6 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Mason Industries, Inc.
3. Unistrut.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.7 SEISMIC-RESTRAINT ACCESSORIES

A Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Kinetics Noise Control, Inc.

3. Mason Industries, Inc.

B. Hanger-Rod Stiffener: Reinforcing steel angle clamped to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.8 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having

jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Comply with requirements in Section 077200 "Roof Accessories" for installation of equipment supports and roof penetrations.

D. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

E. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction that provides required submittals for component per State of Connecticut Building Code.

F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 211200 "Fire-Suppression Standpipes," Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for piping flexible connections.

3. 5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Perform tests and inspections.
C. Tests and Inspections:
1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.

8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

END OF SECTION 210548

SECTION 210553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Samples: For color, letter style, and graphic representation required for each identification material and device.

D. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

E. Valve Schedules: Valve numbering scheme.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each piping system to include in maintenance manuals.

1.5 RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(d) (13):

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

PART 2 – PRODUCTS

2. 1 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, ½ inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; pipe size; and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.

2. Lettering Size: At least 1-1/2 inches high.

E. Pipe-Label Colors:

1. Background Color: Red.

2. Letter Color: White.

2.3 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational

instructions.

1. Stencil Material: Aluminum.
2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.032 inch thick, with predrilled holes for attachment hardware.
   2. Fasteners: Brass beaded chain.
   3. Valve-Tag Color: Red.
   4. Letter Color: White.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: Approximately 4 by 7 inches.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
   4. Color: Yellow background with black lettering.

PART 3 – EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 LABEL INSTALLATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install or permanently fasten labels on each major item of mechanical equipment.

D. Locate equipment labels where accessible and visible.

E. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

F. Stenciled Pipe-Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

G. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:.

1. Near each valve and control device.
2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3. 3 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems. List tagged valves in a valve-tag schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:
   a. Fire-Suppression Standpipe: 2 inches, square.
   b. Wet-Pipe Sprinkler System: 2 inches, square.
   c. Dry-Pipe Sprinkler System: 2 inches, square.

3.4 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 210553

SECTION 211119 - FIRE-DEPARTMENT CONNECTIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exposed-type fire-department connections.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each fire-department connection.

C. RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k- 4(d) (13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

PART 2 – PRODUCTS

2.1 EXPOSED-TYPE FIRE-DEPARTMENT CONNECTION

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Fire Hose & Cabinet.
   a. Elkhart Brass Mfg. Company, Inc.
   b. Fire-End & Croker Corporation.
      i. Standard: UL 405.
      ii. Type: Exposed, projecting, for wall mounting.

iii. Pressure Rating: 175 psig minimum.

iv. Body Material: Corrosion-resistant metal.

v. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

vi. Caps: Brass, lugged type, with gasket and chain.

vii. Escutcheon Plate: Round, brass, wall type.

viii. Outlet: Back, with pipe threads.

J. Number of Inlets: Two.

K. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."

L. Finish: Polished chrome plated.

M. Outlet Size: NPS 4.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fire-department connections.

B. Examine roughing-in for fire-suppression standpipe system to verify actual locations of piping connections before fire-department connection installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-type fire-department connections.

B. Confrim local fire department connection size and type.

C. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

END OF SECTION 211119

SECTION 211200 - FIRE-SUPPRESSION STANDPIPES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection specialty
3. Hose connections.
4. Alarm devices.
5. Manual control stations.
6. Control panels.
7. Pressure gages.

B. Related Requirements:

1. Section 210523 "General-Duty Valves for Water-Based Fire-Suppression Piping."
2. Section 211119 "Fire-Department Connections" for exposed wall-mounted and yard fire hydrants.
3. Section 211213 "Fire-Suppression Hoses and Nozzles" for rack-type hose stations, reel-type hose stations, and monitors.
4. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
5. Section 211316 "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.
6. Section 283111 "Digital, Addressable Fire-Alarm System" Section 283112 "Zoned (DC Loop) Fire-Alarm System" for connections to alarm devices.

C. Related Sections

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k- 4(d) (13):

2 The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 DEFINITIONS

A. High-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure higher than standard 175 psig, but not higher than 250 psig (1725 kPa).

B. Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at

working pressure 175 psig maximum.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Shop Drawings: For fire-suppression standpipes.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

D. Delegated-Design Submittal: For standpipe systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified State of CT professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Fire-suppression standpipes, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Domestic water piping.
2. Compressed-air piping.
3. HVAC hydronic piping.

B. Qualification Data: For Installer and professional engineer.

C. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Welding certificates.

E. Fire-hydrant flow test report.

F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

G. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-suppression standpipes specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified State of CT professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified State of CT testing agency, and marked for intended location and application.

D. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14.

PART 2 – PRODUCTS

2.1 SYSTEM DESCRIPTIONS

A. Automatic Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

B. Automatic Wet-Type, Class II Standpipe System: Includes NPS 1-1/2 hose stations. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

C. Automatic Dry-Type, Class I Standpipe System: Includes NPS 2-1/2 hose connections. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air or nitrogen. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.

D. Automatic Dry-Type, Class II Standpipe System: Includes NPS 1-1/2 hose stations. Has open water-supply valve and dry-pipe valve with standpipes containing compressed air or nitrogen. Opening fire-hose valve releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into standpipes.

2.2 PERFORMANCE REQUIREMENTS

A. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design fire-suppression standpipes, including comprehensive engineering analysis by a qualified State of CT professional engineer, using performance requirements and design criteria indicated.

1. The Town of Watertown is extending the water service approximately 7,000 LF to the site. Upon completion perform a hydrant flow test and record the following information:
2.
    a. Date:
    b. Time: a.m., p.m.
    c. Performed by: Insert operator's name and name of firm.
    d. Location of Residual Fire Hydrant R: Insert location.
    e. Location of Flow Fire Hydrant F: Insert location.
    f. Static Pressure at Residual Fire Hydrant R: Insert psig.
    g. Measured Flow at Flow Fire Hydrant F: gpm.
    h. Residual Pressure at Residual Fire Hydrant R: psig.

C. Fire-suppression standpipe design shall be approved by authorities having jurisdiction.
1. Minimum residual pressure at each hose-connection outlet is as follows:
    a. NPS 1-1/2 Hose Connections: 65 psig.
    b. NPS 2-1/2 Hose Connections: 65 psig.

D. Seismic Performance: Fire-suppression standpipes shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

2.3 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials and for joining methods for specific services, service locations, and pipe sizes.

2.4 GALVANIZED-STEEL PIPE AND ASSOCIATED FITTINGS

A. Schedule 40: ASTM A 53/A 53M, Type E, Grade B; with factory- or field-formed ends to accommodate joining method.
B. Schedule 40: ASTM A 135/A 135M, Grade A; with factory- or field-formed ends to accommodate joining method.
C. Schedule 40: ASTM A 795/A 795M, Type E, Grade A; with factory- or field-formed ends to accommodate joining method.
D. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless steel pipe with threaded ends.
E. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
F. Malleable-Iron Unions:
    1. ASME B16.39, Class 150.
    2. Hexagonal-stock body.

3. Ball-and-socket, metal-to-metal, bronze seating surface.
4. Threaded ends.

G. Flanges: ASME B16.1, Class 125, cast iron.

H. Appurtenances for Grooved-End, Galvanized-Steel Pipe:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International, Inc.
   b. Grinnell Mechanical Products; Tyco Fire Products LP.
   c. Victaulic Company.
2. Fittings for Grooved-End, Galvanized-Steel Pipe: Galvanized, ASTM A 47/A 47M, malleable-iron casting; ASTM A 106/A 106M, steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
3. Fittings for Grooved-End, Galvanized-Steel Pipe:
   a. AWWA C606 for steel-pipe dimensions.
   b. Ferrous housing sections.
   c. EPDM-rubber gaskets suitable for hot and cold water.
   d. Bolts and nuts.
   e. Minimum Pressure Rating:
      1) NPS 8 and Smaller: 600 psig.
      2) NPS 10 and NPS 12: 400 psig.
      3) NPS 14 to NPS 24: 250 psig.

2.5 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or FM Global's "Approval Guide."
2. Pressure Rating:
   a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Tyco Fire & Building Products LP
   b. Victaulic Company.
   c. Viking Corporation.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Dry-Pipe Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Tyco Fire & Building Products LP.
   b. Victaulic Company.
   c. Viking Corporation.
2. Standard: UL 260.
3. Design: Differential-pressure type.
4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
5. Air-Pressure Maintenance Device:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers

offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Tyco Fire & Building Products LP
2) Victaulic Company.
3) Viking Corporation.

b. Standard: UL 260.

c. Type: Automatic device to maintain minimum air pressure in piping.

d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.

6. Air Compressor:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Gast Manufacturing Inc.
2) General Air Products, Inc.
3) Viking Corporation.

b. Standard: UL's "Fire Protection Equipment Directory" listing.

c. Motor Horsepower: Fractional.

d. Power: 120-V ac, 60 Hz, single phase.

C. Deluge Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Tyco Fire & Building Products LP.

b. Victaulic Company.

c. Viking Corporation

2. Standard: UL 260.

3. Design: Hydraulically operated, differential-pressure type.

4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.

5. Wet, Pilot-Line Trim Set: Include gage to read push-rod chamber pressure, globe valve for manual operation of deluge valve, and connection for actuation device.

6. Dry, Pilot-Line Trim Set: Include dry, pilot-line actuator; air- and water-pressure gages; low-air-pressure warning switch; air relief valve; and actuation device. Dry, pilot-line actuator includes cast-iron, operated, diaphragm-type valve with resilient facing plate, resilient diaphragm, and replaceable bronze seat. Valve includes threaded water and air inlets and water outlet. Loss of air pressure on dry, pilot-line side allows pilot-line actuator to open and causes deluge valve to open immediately.
7. Air-Pressure Maintenance Device:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Tyco Fire & Building Products LP.
      2) Victaulic
      3) Viking Corporation.
   b. Standard: UL 260.
   c. Type: Automatic device to maintain minimum air pressure in piping.
   d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator, or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 300-psig outlet pressure.
8. Air Compressor:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Gast Manufacturing Inc.
      2) General Air Products, Inc.
      3) Viking Corporation.
   b. Standard: UL's "Fire Protection Equipment Directory" listing.
   c. Motor Horsepower: Fractional.
   d. Power: 120-V ac, 60 Hz, single phase.

E Pressure-Reducing Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Guardian Fire Equipment, Inc.
   b. Potter Roemer.
   c. Zurn Plumbing Products Group; Wilkins Water Control Products
2. UL 668 hose valve, with integral UL 1468 reducing device.

3. Pressure Rating: 300 psig minimum.
4. Material: Brass or bronze.
5. Inlet: Female pipe threads.
6. Outlet: Threaded with or without adapter having male hose threads.
7. Pattern: Angle or gate.
8. Finish: Polished chrome-plated.

E. Automatic (Ball Drip) Drain Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Reliable Automatic Sprinkler Co., Inc.
b. Tyco Fire & Building Products LP.
c. Viking.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.7 HOSE CONNECTIONS

A. Nonadjustable-Valve Hose Connections:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Elkhart Brass Mfg. Company, Inc.
b. Potter Roemer.
c. Tyco Fire & Building Products LP
2. Standard: UL 668 hose valve for connecting fire hose.
3. Pressure Rating: 300 psig minimum.
4. Material: Brass or bronze.
5. Size: NPS 1-1/2 or NPS 2-1/2, as indicated.
6. Inlet: Female pipe threads.
7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
8. Pattern: Angle or gate.
9. Finish: Polished chrome-plated.

2.8 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Notifier; a Honeywell company.
   c. Potter Electric Signal Company.
2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: 10-inch diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

C. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. McDonnell & Miller; ITT Industries.
   b. Potter Electric Signal Company.
   c. Viking Corporation.
2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

D. Pressure Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Potter Electric Signal Company
   b. Tyco Fire & Building Products LP
   c. Viking Corporation..

2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

E. Valve Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Kennedy Valve; a division of McWane, Inc.
   c. Potter Electric Signal Company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

E. Indicator-Post Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Potter Electric Signal Company.
   b. System Sensor; a Honeywell company.
   c. Viking.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.9 MANUAL CONTROL STATIONS

A. Description: UL listed or FM Global approved, hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.10 CONTROL PANELS

A. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves. Panels contain power supply; battery charger; standby batteries; field-wiring terminal strip; electrically supervised solenoid valves and polarized fire-alarm bell; lamp test facility; single-pole, double-throw auxiliary alarm contacts; and rectifier.

1. Panels: UL listed and FM Global approved when used with thermal detectors and Class A detector circuit wiring. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
2. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.
3. Manual Control Stations: Hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.11 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AMETEK; U.S. Gauge Division.
2. Ashcroft Inc.
3. Brecco Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: Zero to 250 psig minimum.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 – EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 14 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 SERVICE-ENTRANCE PIPING

A. Connect fire-suppression standpipe piping to water-service piping at service entrance into building.

B. Install shutoff valve, double check valve assembly backflow preventer, pressure gage, drain, and other accessories at connection to fire-suppression water-service piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.4 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.

C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.

D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install drain valves on standpipes. Extend drain piping to outside of building.

F. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.

G. Install alarm devices in piping systems.

H. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.

I. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

J. Drain dry-type standpipe system piping.

K. Pressurize and check dry-type standpipe system piping and air compressors.

L. Fill wet-type standpipe system piping with water.

M. Install electric heating cables and pipe insulation on wet-type fire-suppression standpipe piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."

N. Connect compressed-air or nitrogen supply to dry-pipe sprinkler piping.

O. Connect air compressor to the following piping and wiring:

1. Pressure gages and controls.
2. Electrical power system.
3. Fire-alarm devices, including low-pressure alarm.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.5 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

J. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

L. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

M. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.6 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Install bypass check valve and retarding chamber drain-line connection.
3. Dry-Pipe and Deluge Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
    a. Install air compressor and compressed-air supply piping.
    b. Air-Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig adjustable range; and 175-psig maximum inlet pressure.
    c. Install compressed-air supply piping from building's compressed-air piping system.

3.7 HOSE-CONNECTION INSTALLATION

A. Install hose connections adjacent to standpipes.

B. Install freestanding hose connections for access and minimum passage restriction.

C. Install NPS 1-1/2 hose-connection valves with flow-restricting device.

D. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter and flow-restricting device.

E. Install wall-mounted-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Section 104413 "Fire Protection Cabinets."

3.8 HOSE-STATION INSTALLATION

A. Install freestanding hose stations for access and minimum passage restriction.

B. Install NPS 1-1/2 hose-station valves with flow-restricting device unless otherwise indicated.

C. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter and flow-restricting device unless otherwise indicated.

D. Install freestanding hose stations with support or bracket attached to standpipe.

E. Install wall-mounted, rack hose stations in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Section 104413 "Fire Protection Cabinets."

F. Install hose-reel hose stations on wall with bracket.

3.9 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type fire-department connections.

B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.10 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.12 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.13 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

B. Standard-pressure, wet-type fire-suppression standpipe piping, NPS 4 and smaller, shall be one of the following:

1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
3. Schedule 40, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
4. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

C. Standard-pressure, wet-type fire-suppression standpipe piping, NPS 5 to NPS 8, shall be one of the following:

1. Schedule 40, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Black-steel pipe with plain ends; steel welding fittings; and welded joints.

D. Standard-pressure, wet-type fire-suppression standpipe piping, NPS 10 and NPS 12, shall be one of the following:

1. Schedule 40, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

E. Standard-pressure, dry-type fire-suppression standpipe piping, NPS 4 and smaller, shall be one of the following:

1. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
2. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

F. Standard-pressure, dry-type fire-suppression standpipe piping, NPS 5 and NPS 6, shall be one of the following:

1. Schedule 40, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

END OF SECTION 211200

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and
2. Fire-protection valves.
3. Sprinklers.
4. Alarm devices.
5. Manual control stations.
6. Control panels.
7. Pressure gages.

B Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(d) (13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.
3. Section 211119 "Fire-Department Connections" for exposed-, flush-, and yard-type fire-department connections.
4. Section 211200 "Fire-Suppression Standpipes" for standpipe piping.
5. Section 211316 "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.

1.3 DEFINITIONS

a. High-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure higher than standard 175 psig, but not higher than 250 psig.
b. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

B. Deluge Sprinkler System: Open sprinklers are attached to piping connected to water supply through deluge valve. Fire-detection system, in same area as sprinklers, opens valve. Water flows into piping system and discharges from attached sprinklers when valve opens.

1.5 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

1. The Town of Watertown is extending the water service approximately 7,000 LF to the site. Upon completion perform a hydrant flow test and record the following information:

a. Date:

b. Time: a.m., p.m.

c. Performed by: Insert operator's name and name of firm.

d. Location of Residual Fire Hydrant R: Insert location.

e. Location of Flow Fire Hydrant F: Insert location.

f. Static Pressure at Residual Fire Hydrant R: Insert psig.

g. Measured Flow at Flow Fire Hydrant F: gpm.

h. Residual Pressure at Residual Fire Hydrant R: psig.

B. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.

2. Area Density column based on FM Global Standards.

3. Sprinkler "K" factors based on FM Global Standards

WATER REQUIREMENTS

Sprinkler Zone	Fire Service Entrance /Area	Density/Area GPM/SF	GPM	Hose Stream-GPM	Total Flow GPM	System Type	Sprinkler "K" factor
4 - Operations	4 / 8,385 SF	0.10 GPM/1,500 SF	150	250	400	Wet	5.6
4A- Pump Room/Vestibule	5 / 8,117 SF	0.10 GPM/1,500SF	150	250	400	Wet	5.6
5- Administration	4 / 9,363 SF	0.10 GPM/1,500 SF	150	500	600	Wet	5.6
5A- Vestibule	4 / 1,438 SF	0.10 GPM/1,500 SF	150	500	600	Wet	5.6
6- Maintenance	4 / 18,326 SF	0.30 GPM/4,000 SF	1,200	500	1,700	Wet	8.0/ 286°F
6A- Hazardous Material Storage	4	0.40 GPM/2,500 SF	1,000	500	1,500	Wet	11.2
6B- Paint Spray Booth Area	4	0.40 GPM/2,500 SF	1,000	500	1,500	Wet	11.2
7- Maintenance	3 / 19,711 SF	0.30 GPM/4,000 SF	1,200	500	1,700	Wet	8.0/ 286°F
7A- Lubricating Oil Storage	3	0.40 GPM/2,500 SF	1,000	500	1,500	Wet	11.2
8- Tire Room	3 /1,572 SF	0.40 GPM/2,500 SF	1,000	500	1,500	Wet	11.2/ 160°F
8- Tire Storage Carousel	3	2 Sprinklers per carousel /30 GPM ea	120 GPM	500	620	Wet	8.0/ 160°F
10- Bus Storage	5 / 14,000 SF	0.30 GPM/4,000 SF	1,200	500	1,700	Wet	8.0/ 286°F
10A- Bus Storage	6 / 15,463 SF	0.30 GPM/4,000 SF	1,200	500	1,700	Wet	8.0/ 286°F
11- Bus Storage	1 / 38,083 SF	0.30 GPM/4,000 SF	1,200	500	1,700	Wet	8.0/ 286°F
12- Bus Cleaning	1 / 10,733 SF	0.30 GPM/4,000 SF	1,200	500	1,700	Wet	8.0/ 286°F
13- Interior Fueling	2 / 5,533 SF	0.30 GPM/4,000 SF	1,200	500	1,700	Wet	8.0/ 286°F
14- Bus Storage	2 / 30,787 SF	0.30 GPM/4,000 SF	1,200	500	1,700	Wet	8.0/ 286°F

Sprinkler Zone	Protection Area	Maximum Sprinkler Spacing
4 - Operations	225 SF	15'
4A- Pump Room/Vestibule	225 SF	15'
5- Administration	225 SF	15'
5A- Vestibule	225 SF	15'
6- Maintenance	100 SF	12'
6A- Hazardous Mate rial Storage	100 SF	12'
6B- Paint Spray Booth Area	100 SF	12'
7- Maintenance	100 SF	12'
7A- Lubricating Oil Storage	100 SF	12'
8- Tire Room	100 SF	12'
8- Tire Storage Carousel	2 Carousels	2 Sprinklers per carousel /30 GPM ea
10- Bus Storage	100 SF	12'
10A- Bus Storage	100 SF	12'
11- Bus Storage	100 SF	12'
12- Bus Cleaning	130 SF	12'
13- Interior Fueling	100 SF	12'
14- Bus Storage	100 SF	12'

C. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.6 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. LEED Submittal:

1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content and chemical components.

D. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

E. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Domestic water piping.
2. Compressed air piping.
3. HV AC hydronic piping.
4. HVAC Ductwork.
5. Fire Suppression piping
6. Items penetrating finished ceiling include the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.

F. Qualification Data: For qualified Installer and qualified professional engineer licensed in the State of Connecticut.

G. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

H. Welding certificates.

I. Fire-hydrant flow test report.

J. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

K. Field quality-control reports. Operation and Maintenance Data: For sprinkler specialties to include in emergency operation, and maintenance manuals.

1.7 QUALITY ASSURANCE SUBMITTALS

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."

2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."

3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

E. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wet pipe sprinkler systems to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Spare Parts: for wet pipe sprinkler systems specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

C. Training: for wet pipe sprinkler systems specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.9 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space

for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.11 FM Global Data Sheets

A. Conform to the following FM Global Data Sheets as applicable in addition to NFPA 13.

1. FM 2.0 Inst Guidelines for Automatic Sprinkler Systems FMDS0200
2. FM 3-10 Installation and Maintenance of Private Fire Service Mains
3. FM 7-32 Ignitable Liquid Operations FMDS0732
4. FM 7-78 Industrial Exhaust Systems
5. FM 7-83 Drainage and Containment Systems for Ignitable Liquids FMDS0783
6. FM 8-3 Rubber Tire Storage FMDS0803

PART 2 – PRODUCTS

2. 1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Uncoated, Steel Couplings: ASTM A 865, threaded.

D. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME 16.1, Class 125.

G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

I. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc.
b. Tyco Fire & Building Products
c. Victaulic Company.

2. Pressure Rating: 175 psig minimum.
3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

J. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic and asbestos free.
   1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
   2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493, solvent cement recommended by pipe and fitting manufacturer, and made for joining CPVC sprinkler pipe and fittings. Include cleaner or primer recommended by pipe and fitting manufacturer.
   1. Use solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Use adhesive primer that has a VOC content of 650 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Plastic, Pipe-Flange Gasket, and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 LISTED FIRE-PROTECTION VALVES

A General Requirements:
   1. Valves shall be UL listed or FM approved.
   2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
   3. Minimum Pressure Rating for High-Pressure Piping: 250 psig.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International, Inc.
   b. Victaulic Company.

2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fivalco Inc.
   b. Global Safety Products, Inc.
   c. Milwaukee Valve Company.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

D, Iron Butterfly Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Anvil International, Inc.
   b. Victaulic Company
   c. NIBCO INC.

2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.

6. End Connections: Grooved.
7. Standard: UL 1091.
8. Pressure Rating: 175 psig.
9. Body Material: Cast or ductile iron.
10. Style: Lug or wafer.
11. End Connections: Grooved.

E. Check Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International, Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company..
2. Standard: UL 312.
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron
6 End Connections: Flanged or grooved.

F. Bronze OS&Y Gate Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Crane Co.; Crane Valve Group; Stockham Division.
   b. NIBCO INC.
   c. United Brass Works, Inc.
2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

G. Iron OS&Y Gate Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hammond Valve.
b. Tyco Fire & Building Products LP.
c. Mueller Co.; Water Products Division.

2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

H. NRS Gate Valves:

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Kennedy Valve; a division of McWane, Inc.
   b. Mueller Co.; Water Products Division.
   c. Tyco Fire & Building Products LP.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast iron with indicator post flange.
5. Stem: Nonrising.
6. End Connections: Flanged or grooved.

I. Indicator Posts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Kennedy Valve; a division of McWane, Inc.
   b. Mueller Co.; Water Products Division.
   c. Clow Valve Company; a division of McWane, Inc.
2. Standard: UL 789.
3. Type: Horizontal for wall mounting.
4. Body Material: Cast iron with extension rod and locking device.
5. Operation: Wrench.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Fire Protection Products, Inc.

   b. United Brass Works, Inc.

C. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Kitz Corporation
   b. Potter Roemer.
   c. NIBCO INC.

D. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Fire Protection Products, Inc.

   b. United Brass Works, Inc.

   c. NIBCO INC.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

2. Pressure Rating:

   a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.

   b. High-Pressure Piping Specialty Valves: 250 psig minimum.

3. Body Material: Cast or ductile iron.

4. Size: Same as connected piping.

5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following::

   a. Tyco Fire & Building Products LP.
   b. Victaulic Company.
   c. Viking Corporation.

2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Deluge Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Tyco Fire & Building Products LP.
   b. Reliable Automatic Sprinkler Co.,
   c. . Victaulic Company

2. Standard: UL 260.
3. Design: Hydraulically operated, differential-pressure type.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, drip cup assembly piped without valves and separate from main drain line, fill-line attachment with strainer, and push-rod chamber supply connection.
5. Wet, Pilot-Line Trim Set: Include gage to read push-rod chamber pressure, globe valve for manual operation of deluge valve, and connection for actuation device.

D. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. AFAC Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.7 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements available manufacturers

offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc.

b. Tyco Fire & Building Products LP.

c. Victaulic Company.

2. Standard: UL 213.

3. Pressure Rating: 175 psig minimum.

4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.

5. Type: Mechanical-T and -cross fittings.

6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.

7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.

8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Reliable Automatic Sprinkler Co., Inc.

b. Tyco Fire & Building Products LP.

c. Victaulic Company.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

3. Pressure Rating: 175 psig minimum.

4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.

5. Size: Same as connected piping.

6. Inlet and Outlet: Threaded.

C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Elkhart Brass Mfg. Company, Inc.

b. Fire-End & Croker Corporation.

c. Potter Roemer.

2. Standard: UL 199.

3. Pressure Rating: 175 psig.

4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Tyco Fire & Building Products
   b. Victaulic Company.
   c. Viking Corporation.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. CECA, LLC.
   b. Corcoran Piping System Co.
   c. Merit Manufacturing; a division of Anvil International, Inc.
2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum].
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

2.8 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Tyco Fire & Building Products LP..
2. Victaulic Company.
3. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
4. Pressure Rating for High-Pressure Automatic Sprinklers: 250 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767
2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Open Sprinklers with Heat-Responsive Element Removed: UL 199.

1. Characteristics:
   a. Nominal 1/2-inch Orifice: With Discharge Coefficient K between 5.3 and 5.8.
   b. Nominal 17/32-inch Orifice: With Discharge Coefficient K between 7.4 and 8.2.
   c. Nominal 3/4-inch Orifice: With Discharge Coefficient K 11.2.

E. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.
3. Painted.

F. Special Coatings:

1. Wax.
2. Lead.
3. Corrosion-resistant paint.

G. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch vertical adjustment.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

H. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Tyco Fire & Building Products LP.

   b. Victaulic Company.

   c. Viking Corporation.

2. Standard: UL 199.

3. Type: Wire cage with fastening device for attaching to sprinkler.

2.9 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Fire-Lite Alarms, Inc.; a Honeywell company.

   b. Notifier; a Honeywell company.

   c. Potter Electric Signal Company.

2. Standard: UL 464.

3. Type: Vibrating, metal alarm bell.

4. Size: 10-inch diameter.

5. Finish: Red-enamel factory finish, suitable for outdoor use.

C. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Viking Corporation.

   b. McDonnell & Miller; ITT Industries.

   c. Potter Electric Signal Company.

2. Standard: UL 346.

3. Water-Flow Detector: Electrically supervised.

4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field- adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

D. Pressure Switches:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Potter Electric Signal Company.
   b Viking Corporation.
   c. Tyco Fire & Building Products LP.
2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

E. Valve Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fire-Lite Alarms, Inc.; a Honeywell company.
   b. Kennedy Valve; a division of McWane, Inc.
   c. Potter Electric Signal Company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

F. Indicator-Post Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Potter Electric Signal Company.
   b. System Sensor; a Honeywell company.
   c. Vining..
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.

5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.10 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.
3. Brecco Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 250 psig minimum.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 – EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 211100 "Facility Fire-Suppression Water-Service Piping."

B. Install shutoff valve, double check valve assembly backflow assembly, pressure gage, drain, and other accessories indicated at connection to water-service piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials

and installation in NFPA 13.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

K. Install alarm devices in piping systems.

L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

N. Pressurize and check preaction sprinkler system piping and air compressors.

O. Fill sprinkler system piping with water.

P. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire- Suppression Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that

have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

N, Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

O. Copper-Tubing Grooved Joints: Roll rounded-edge groove in end of tube according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-

end fittings according to AWWA C606 for steel-pipe grooved joints.

P. Copper-Tubing, Pressure-Sealed Joints: Join copper tube and copper pressure-seal fittings with tools recommended by fitting manufacturer.

Q. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

R. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

S. Plastic-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3.5 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and with NFPA 13 or NFPA 13R for supports.

3.6 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.
3. Deluge Valves: Install in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

3. 7 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.8 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter and should be flushed and hydrostatically tested in accordance with FM Global Data Sheet 3-10, Installation and Maintenance of Private Service Mains and Their Appurtenances. FM Global Form 85B, Contractor’s Material & Test Certificate for Underground Piping should be completed and submitted to FM Global for review.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and air compressors.

3.12 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight

steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

E. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 , shall be one of the following:

1. Standard-weight, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

F. Standard-pressure, wet-pipe sprinkler system, NPS 5 and larger , shall be one of the following:

1. Standard-weight, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.13 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Recessed sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Spaces Subject to Freezing: Upright sprinklers Sidewall, dry sprinklers.
5. Deluge-Sprinkler Systems: Upright and pendent, open sprinklers.
6. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

C. Extend a single, quick-response style ordinary temperature, minimum K5.6 rated sprinkler head to within 2 ft. vertically of all fuel and lubricating oil transfer pumps.

END OF SECTION 211313

SECTION 211316 - DRY-PIPE SPRINKLER SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinkler specialty pipe
5. Sprinklers.
6. Alarm devices.
7. Manual control stations.
8. Control panels.
9. Pressure gages.

B. Related Sections:

1. Section 211119 "Fire-Department Connections" for exposed-, flush-, and yard-type fire-department connections.
2. Section 211200 "Fire-Suppression Standpipes" for standpipe piping.
3. Section 211313 "Wet-Pipe Sprinkler Systems" for wet-pipe sprinkler piping.
4. Section 283111 "Digital, Addressable Fire-Alarm System" Section 283112 "Zoned (DC Loop) Fire-Alarm System" for alarm devices not specified in this Section.
5. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k- 4(d) (13):
   A. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS

A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from sprinklers that are open.

B. Combined Dry-Pipe and Preaction Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Fire-detection system in same area as sprinklers actuates tripping devices that open dry-pipe valve without loss of air pressure and actuates fire alarm. Water discharges from sprinklers that have opened.

C. Single-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of fire-detection system in same area as sprinklers opens deluge valve, permitting water to flow into piping and to discharge from sprinklers that have opened.

D. Double-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system in the same area as sprinklers opens the deluge valve permitting water to flow into the sprinkler piping; a closed solenoid valve in the sprinkler piping is opened by another fire-detection device; then water will discharge from sprinklers that have opened.

1.5 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1 The Town of Watertown is extending the water service approximately 7,000 LF to the site. Upon completion perform a hydrant flow test and record the following information:

a. Date:

b. Time: a.m., p.m.

c. Performed by: Insert operator's name and name of firm.

d. Location of Residual Fire Hydrant R: Insert location.

e. Location of Flow Fire Hydrant F: Insert location.

f. Static Pressure at Residual Fire Hydrant R: Insert psig.

g. Measured Flow at Flow Fire Hydrant F: gpm.

h. Residual Pressure at Residual Fire Hydrant R: psig.

C. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.

2. Area Density column based on FM Global Standards.

3. Sprinkler "K" factors based on FM Global Standards

4. Water requirements:

Sprinkler Zone	Fire Service Entrance /Area	Density/Area GPM/SF	GPM	Hose Stream-GPM	Total Flow GPM	System Type	Sprinkler "K" factor
1- Employee Parking	6 / 32,700 SF	0.20 GPM/3,500 SF	700	250	950	Dry	8.0
2- Employee Parking	5 / 28,960 SF	0.20 GPM/3,500 SF	700	250	950	Dry	8.0
3- Employee Parking	3 / 24,710 SF	0.20 GPM/3,500 SF	700	250	950	Dry	8.0
7B- Maintenance Overhead Door Area	3	0.30 GPM/4,000 SF	1,200	500	1,700	Dry	8.0/ 286°F
9- Bus Storage Overhead Door Area	6 / 3,163 SF	0.30 GPM/4,000 SF	1,200	500	1,700	Dry	8.0/ 286°F

Protection Areas and Maximum Spacing of Sprinklers

Sprinkler Zone	Protection Area	Maximum Sprinkler Spacing
1- Employee Parking	130 SF	15'
2- Employee Parking	130 SF	15'
3- Employee Parking	130 SF	15'
7B-Maintenance Overhead Door Area	100 SF	12'
9- Bus Storage Over-head Door Area	100 SF	12'
15- Bus Storage Over-head Door Area	100 SF	12'

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

E For the dry sprinkler areas for the large overhead doors the system shall be designed such that water can be delivered to the most remote sprinkler within 30 seconds of activation in a fire per FM Global Data Sheet 7-32.

1.6 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. iN.

C. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

D. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified State of CT professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Domestic water piping.
2. Compressed air piping.
3. HV AC hydronic piping.
4. HVAC Ductwork.
5. Fire Suppression System
6. Items penetrating finished ceiling including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.

B. Qualification Data: For qualified Installer and professional engineer licensed in the State of Connecticut.

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13 and FM Global, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Fire-hydrant flow test report.

E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and FM Global. Include "Contractor's Material and Test Certificate for Aboveground Piping."

F. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For dry pipe sprinkler systems to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Training: For dry pipe sprinkler systems specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1. 9 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.10 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing qualified State of CT professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

D. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.11 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.13 FM Global Data Sheets

A. Conform to the following FM Global Data Sheets as applicable in addition to NFPA 13.

1. FM 2.0 Inst Guidelines for Automatic Sprinkler Systems FMDS0200
2. FM 3-10 Installation and Maintenance of Private Fire Service Mains
3. FM 7-32 Ignitable Liquid Operations FMDS0732

4. FM 7-78 Industrial Exhaust Systems
5. FM 7-83 Drainage and Containment Systems for Ignitable Liquids FMDS0783
6. FM 8-3 Rubber Tire Storage FMDS0803

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Standard Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E , . Pipe ends may be factory or field formed to match joining method.

B Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Galvanized, Steel Couplings: ASTM A 865, threaded.

D. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Anvil International, Inc.
   b. Tyco Fire & Building Products
   c. Victaulic Company.

2. Pressure Rating: 175 psig minimum.
3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2. 3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron and Class 300, Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general- duty brazing unless otherwise indicated.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International, Inc.
   b. Victaulic
   c. Potter Roemer Company.
2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fivalco Inc.
   b. Global Safety Products, Inc.
   c. Milwaukee Valve Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

D. Iron Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International, Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company
2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.
6. End Connections: Grooved.

7. Standard: UL 1091.
8. Pressure Rating: 175 psig.
9. Body Material: Cast or ductile iron.
10. Style: Lug or wafer.
11. End Connections: Grooved.

D. Check Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International, Inc.
   b. Victaulic Company.
   c. Viking Corporation.
2. Standard: UL 312
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved

E. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Tyco Fire & Building Products LP
   b. Hammond Valve..
   c. Mueller Co.; Water Products Division.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

F. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International, Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
2. Standard: UL 1091.

3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2 and Smaller:
   a. Valve Type: Ball or butterfly.
   b. Body Material: Bronze.
   c. End Connections: Threaded.
5. Valves NPS 2-1/2 and Larger:
   a. Valve Type: Butterfly.
   b. Body Material: Cast or ductile iron.
   c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral visual indicating device.

G. NRS Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Mueller Co.; Water Products Division.
   b. NIBCO INC.
   c. Tyco Fire & Building Products LP.
2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum .
4. Body Material: Cast iron with indicator post flange.
5. Stem: Nonrising.
6. End Connections: Flanged or grooved.

H. Indicator Posts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Cast Iron Pipe Company; Waterous Company
   b. Kennedy Valve; a division of McWane, Inc.
   c. Mueller Co.; Water Products Division.
2. Standard: UL 789.
3. Type: Horizontal for wall mounting.
4. Body Material: Cast iron with extension rod and locking device.
5. Operation: Wrench .

2. 5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.

B. Angle Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fire Protection Products, Inc.
   b. United Brass Works, Inc.

C. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International, Inc.
   b. NIBCO INC.
   c. Potter Roemer.

D. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fire Protection Products, Inc.
   b. United Brass Works, Inc.
   c. NIBCO INC.

E. Plug Valves:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Southern Manufacturing Group.

2.6 SPECIALTY VALVES

A. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
   a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
   b. High-Pressure Piping Specialty Valves: 250 psig minimum.
3. Body Material: Cast or ductile iron.

4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Dry-Pipe Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Tyco Fire & Building Products LP.
   b. Victaulic Company.
   c. Viking Corporation.

2. Standard: UL 260
3. Design: Differential-pressure type.
4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
5. Air-Pressure Maintenance Device:

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) Tyco Fire & Building Products LP.
      2) Victaulic Company.
      3) Viking Corporation.

   b. Standard: UL 260.
   c. Type: Automatic device to maintain minimum air pressure in piping.
   d. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.

6. Air Compressor:

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Gast Manufacturing Inc.
      2) General Air Products, Inc,
      3) Viking Corporation.
   b. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   c. Motor Horsepower: Fractional.
   d. Power: 120-V ac, 60 Hz, single phase.

7. Automatic (Ball Drip) Drain Valves:

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. AFAC Inc.

b. Reliable Automatic Sprinkler Co., Inc.

c. Tyco Fire & Building Products LP.

B. Standard: UL 1726.

C. Pressure Rating: 175 psig minimum.

D. Type: Automatic draining, ball check

E. Size: NPS 3/4.

F. End Connections: Threaded.

2.7 SPRINKLER SPECIALTY PIPE FITTINGS

A. General Requirements for Dry-Pipe-System Fittings: UL listed for dry-pipe service.

B. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc.

b. Tyco Fire & Building Products LP.

c. Victaulic Company.

2. Standard: UL 213.

3. Pressure Rating: 175 psig minimum.

4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.

5. Type: Mechanical-T and -cross fittings.

6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.

7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.

8. Branch Outlets: Grooved, plain-end pipe, or threaded.

C. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Reliable Automatic Sprinkler Co., Inc.

b. Tyco Fire & Building Products LP.

c. Victaulic Company.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

3. Pressure Rating: 175 psig minimum .
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

D. Branch Line Testers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Elkhart Brass Mfg. Company, Inc.
   b. Fire-End & Croker Corporation.
   c. Potter Roemer.
2. Standard: UL 199.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

E. Sprinkler Inspector's Test Fittings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Tyco Fire & Building Products LP.
   b. Victaulic Company.
   c. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

F. Adjustable Drop Nipples:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. CECA, LLC.

b. Corcoran Piping System Co.

c. Merit Manufacturing; a division of Anvil International, Inc.

2. Standard: UL 1474.

3. Pressure Rating: 250 psig minimum .

4. Body Material: Steel pipe with EPDM O-ring seals.

5. Size: Same as connected piping.

6. Length: Adjustable

7. Inlet and Outlet: Threaded.

2.8 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Tyco Fire & Building Products LP.

2. Victaulic Company.

3. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

2. Pressure Rating for Residential Sprinklers: 175 psig maximum.

3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199.

2. Characteristics: Nominal 1/2-inch orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Chrome plated.

2. Bronze.

3. Painted.

E. Special Coatings:

1. Wax.

2. Lead.

3. Corrosion-resistant paint.

4. Cellophane wrapping.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, one piece, flat.

2. Sidewall Mounting: Chrome-plated steel, one piece, flat

G. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Tyco Fire & Building Products LP.
   b. Victaulic Company.
   c. Viking Corporation.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.9 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Fire-Lite Alarms; a Honeywell company.
   b. Notifier; a Honeywell company.
   c. Potter Electric Signal Company.
2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: 6-inch minimum diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

C. Pressure Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Potter Electric Signal Company
   b. Tyco Fire & Building Products LP..
   c. Viking Corporation

2. Standard: UL 346

3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

D. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers

offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Fire-Lite Alarms; a Honeywell company.

b. Kennedy Valve; a division of McWane, Inc.

c. Potter Electric Signal Company.

2. Standard: UL 346.

3. Type: Electrically supervised.

4. Components: Single-pole, double-throw switch with normally closed contacts.

5. Design: Signals that controlled valve is in other than fully open position.

E. Indicator-Post Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Potter Electric Signal Company.

b. System Sensor; a Honeywell company.

2. Standard: UL 346.

3. Type: Electrically supervised.

4. Components: Single-pole, double-throw switch with normally closed contacts.

5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.10 MANUAL CONTROL STATIONS

A. Description: UL listed or FM Global approved, hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.11 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AMETEK, Inc.; U.S. Gauge Division.

2. Ashcroft, Inc.

3. Brecco Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 250 psig minimum.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements in Section 211100 "Facility Fire-Suppression Water-Service Piping" for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements in NFPA 13 and FM Global for installation of sprinkler piping.

C. Install seismic restraints on piping. Comply with requirements in NFPA 13 and FM Global for seismic-restraint device materials and installation.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains at sufficient low points for complete system drainage.

I. Install all branch piping with a minimum pitch of ½” every 10 ft. and all cross main and feed piping with a minimum pitch of ¼” every 10 ft per FM Global requirements to allow for adequate drainage.

J. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or to outside building.

K. Connect compressed-air supply to dry-pipe sprinkler piping.

L. Connect air compressor to the following piping and wiring:

1. Pressure gages and controls.
2. Electrical power system.
3. Fire-alarm devices, including low-pressure alarm.

M. Install alarm devices in piping systems.

N. Install hangers and supports for sprinkler system piping according to NFPA 13 and FM Global. Comply with requirements in NFPA 13 and FM Global for hanger materials.

O. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

P. Drain dry-pipe sprinkler piping.

Q. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices air compressors.

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

2. Dry-Pipe and Deluge Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

a. Install air compressor and compressed-air supply piping.

b. Air-Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig adjustable range; and 175-psig maximum inlet pressure.

c. Install compressed-air supply piping from building's compressed-air piping system.

3. 6 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

D. Provide sufficient low point drains in the system to allow for adequate drainage of condensation buildup as well as water from trip testing.

E. All branch line piping for the lower level employee parking garage should be pitched a minimum of '1/2 in. every 10 ft. and all cross main and feed main piping should be pitched a minimum of ¼ in. every 10 ft. to allow for adequate drainage.

F. The dry-pipe sprinkler system for the lower level employee parking garage must be capable of providing water to an inspector's test connection at the hydraulically most remote end of the system within 60 seconds of opening the inspector's test connection.

3.7 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Coordinate with fire-alarm tests. Operate as required.
7. Coordinate with fire-pump tests. Operate as required.
8. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from sprinklers. Remove and replace sprinklers with paint other than factory finish.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to

adjust, operate, and maintain specialty valves.

3.11 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, dry-pipe sprinkler system, NPS 2 and smaller , shall be one of the following:

1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

D. Standard-pressure, dry-pipe sprinkler system, NPS 2-1/2 to NPS 4 , shall be the following:

1. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

E. Standard-pressure, dry-pipe sprinkler system, NPS 5 and NPS 6 , shall be the following:

1. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.12 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Dry pendent sprinklers.
3. Wall Mounting: Dry sidewall sprinklers.
4. Spaces Subject to Freezing: Upright sprinklers.
5. Special Applications: Extended-coverage and quick-response sprinklers required.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211316

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 RELATED SECTIONS

A. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d) (13):

1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.4 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 – PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T .

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 220513

SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Flexible-hose packless expansion joints.
2. Metal-bellows packless expansion joints.
3. Rubber packless expansion joints.
4. Grooved-joint expansion joints.
5. Pipe loops and swing connections.
6. Alignment guides and anchors.

B. Related Sections

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d) (13)
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified State of CT professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.

3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of expansion joint, from manufacturer.

1. 6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion fittings and loops for plumbing piping to include in the operations and maintenance manuals specified in form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - SUBMITTALS.

1.7 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 PACKLESS EXPANSION JOINTS

A. Flexible-Hose Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Metraflex Company (The)
   b. Flex-Hose Co., Inc.
   c. Mason Industries, Inc.
2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible- metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.
   a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
   b. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.
5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.
   a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
   b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and

315 psig at 450 deg F ratings.

6. Expansion Joints for Steel Piping NPS 2 and Smaller: Stainless-steel fittings with threaded end connections.
   a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
   b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.
7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Stainless-steel fittings with flanged end connections.
   A. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
   B. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.
8. Expansion Joints for Steel Piping NPS 8 to NPS 12: Stainless-steel fittings with flanged end connections.
   a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F and 90 psig at 600 deg F ratings.
   b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.

2.2 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Hyspan Precision Products, Inc.
      b. Mason Industries, Inc.
      c. Metraflex Company (The)
   2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to p^1p^e.
B. Anchor Materials:
   1. Steel Shapes and Plates: ASTM A 36/A 36M.
   2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
   3. Washers: ASTM F 844, steel, plain, flat washers.
   4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
      a. Stud: Threaded, zinc-coated carbon steel.
      b. Expansion Plug: zinc-coated steel.

c. Washer and Nut: zinc-coated steel.

5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
   a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
   b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
   c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3. 1 EXPANSION-JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

3.2 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
B. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
C. Attach guides to pipe and secure guides to building structure.
D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
E. Anchor Attachments:
   1. Anchor Attachment to Black-Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   2. Anchor Attachment to Galvanized-Steel Pipe: Attach with pipe hangers. Use MSS SP-69, Type 42, riser clamp welded to anchor.
   3. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.
F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
   1. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 220516

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves
2. Stack-sleeve fittings
3. Sleeve-seal systems
4. Sleeve-seal fittings
5. Grout

B. Related Sections

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(d) (13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material, descriptions, dimensions of individual components and profiles, and finishes.

PART 2 - PRODUCTS

1. SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Smith, Jay R. Mfg. Co.
2. Watts Drainage Products
3. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advance Products & Systems, Inc.
2. Metraflex Company (The).
3. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1 Presealed Systems.
2 Hold Rite
3. Lock Seal

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or –PP sleeves.

2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.

2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."

3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.

4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section

078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3. 5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:
   a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves.
   b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves Galvanized-steel-pipe sleeves.
2. Exterior Concrete Walls below Grade:
   a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs-on-Grade:
   a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
   b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
   a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
   b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
5. Interior Partitions:
   a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1. SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

B. Related Sections

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(d) (13)
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.

d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast- brass or split-casting brass type with polished, chrome-plated finish.

e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split- plate, stamped-steel type with exposed-rivet hinge.

f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.

h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated rough-brass finish.

i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split- plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.

j. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated rough-brass finish.

k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.

2. Escutcheons for Existing Piping:

a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.

b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.

c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.

d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.

e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.

f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.

g. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, chrome-plated rough-brass finish.

h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed **[or]** exposed-rivet hinge.

i. Bare Piping in Equipment Rooms: Split-casting brass type with polished, chrome-plated rough-brass finish.

j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1. Section 211200 "Fire-Suppression Standpipes" for fire protection pressure gages.
2. Section 211313 "Wet-Pipe Sprinkler Systems"
3. Section 211316 "Dry-Pipe Sprinkler Systems" for fire protection pressure gages.

1.2 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Light-activated thermometers.
5. Thermowells.
6. Dial-type pressure gages.
7. Gage attachments.
8. Test plugs.
9. Test-plug kits.
10. Sight flow indicators.
11. Compound Water Meter

B. RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section for credit:
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3. ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.4. INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1. 5. CLOSEOUT SUBMITTALS

A. Maintenance Data: For meters and gages for plumbing piping to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

PART 2 - PRODUCTS

2. IMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ashcroft Inc.
2. Trerice, H. O. Co
3. Marsh Bellofram.

B. Standard: ASME B40.200.

C. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.

E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

F. Connector Size: 1/2 inch , with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

H. Window: Plain glass

I. Ring: Stainless steel

J. Element: Bimetal coil

K. Pointer: Dark-colored metal

L. Accuracy: Plus or minus 1 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Trerice, H. O. Co
   b. Ashcroft Inc.
   c. Marsh Bellofram.
2. Standard: ASME B40.100.
3. Case: Liquid-filled Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 , ASME B 1.20.1 pipe threads and bottom- outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in [psi]
8. Pointer: Dark-colored metal
9. Window: Glass
10. Ring: Metal
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 , ASME B 1.20.1 pipe threads and porous- metal-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass ball , with NPS 1/4 , ASME B1.20.1 pipe threads.

2.5 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Peterson Equipment Co., In
   2. Trerice, H. O. Co.
   3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.6 TEST-PLUG KITS

A Manufacturers: Subject to compliance with requirements, available manufacturers offering products that

may be incorporated into the Work include, but are not limited to, the following:

1. Peterson Equipment Co., In
2. Trerice, H. O. Co.
3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.

D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.

F. Carrying Case: Metal or plastic, with formed instrument padding.

2.7 SIGHT FLOW INDICATORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ernst Co., John C., Inc.
2. Dwyer Instruments, Inc.
3. Emerson Process Management; Brooks Instrument.

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 150 psig.

E. Minimum Temperature Rating: 200 deg F .

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

2.8 COMPOUND WATER METER.

A. The Town of Watertown, CT standard for water meters is the Neptune Compound Water Meter. The water meter supplied and installed under this contract shall meet the Town Standard in all respects. The compound water meter shall consist of a combination of an AWWA Class II turbine meter and a nutating disc type positive displacement meter, in a single maincase. An automatic valve shall direct flows through the disc meter at low flow rates and through the turbine meter at high flow rates. At high flow rates the automatic valve shall restrict the flow through the disc meter to minimize wear. . Maximum continuous flow rate shall 1,400 gpm). The minimum meter flow rate shall be be 3/4 gpm). Each Register shall indicate in U.S. gallons.

B. The water meter shall be rated for use at temperatures ranging from --40° F and 158° F and operate at a working pressure of 1034 kPa (150-psig).

C. The main case and cover shall be cast from an NSF/ANSI 61, Annex G and Annex F certified lead free high copper alloy containing a minimum of 85% copper. The size, model, NSF certification and arrows indicating direction of flow shall be cast in raised characters on the man case or cover. The covers shall contain a stainless steel calibration vane fro the purpose of calibrating the turbine measuring element while the meter is inline and under pressure. A test plug shall be located in the main case of the cover for the purpose of field testing of the meter.

D. Register box and covers shall be of bronze composition. The name of the manufacturer shall be clearly identifiable and located on the register box covers.

E. The turbine measuring chamber shall be a self-contained unit, attached to the cover for easy removal. The turbine shaft shall be tungsten carbide with tungsten carbide inserts and shall rotate in removable graphite bushings. Thrust bearings shall be tungsten carbide.

F. The nutating disc chamber shall be mounted on the cover for easy removal and easily removable from the cover. It shall conform to s AWWA Standard C700. The inlet to the disc chamber shall be a “single” opening of adequate size not to be susceptible to plugging and water restriction by water borne debris.

G. The meter shall have flanged ends and supplied with gaskets and AISI Type 316 stainless steel bolts and nuts.

H. Registration accuracy over the normal operating range shall be 98.5% to 101.5%. Registratio0n at the crossover shall be not less than 95% with direct reading registers. Registratio0n at the crossover shall be not less than 90% with absolute encoder or generator remote registers. Registratio0n at the extended low flow rate shall be not less than 95%.

I. A strainer shall be provided for the disc meter. It shall be easily removable and have an effective straining area of double the disc meter inlet.

J. The intermediate gear train shall be directly coupled to from the turbine rotor and mechanically coupled to the register through the meter cover. The gear train shall be housed in the turbine measuring chamber. All moving parts of the gear train shall be made of a self-lubricating polymer or stainless steel for operation in water.

K. The meter shall be supplied with a pit version E-CODER.

2.9 WATER METER STRAINER

A. The strainer screen shall be made of perforated AISI Type 18-8 stainless steel plate and shall be shaped for maximum rigidity against forces exerted by the flow stream.

B. The effective strainer shall be at least double that of the meter maincase inlet area.

C. Strainers larger than 3” shall be furnished with round flanged connections. Bolt circles, bolt hole diameters, and flange dimensions tance shall be incompliance with meter connection specifications contained in ANSI/AWWA C701.

D. The strainer bodies and covers shall be made from an NSF/ANSI 61, Annex G and Annex F certified lead free high copper alloy containing a minimum of 85% copper. The strainer pipe size, manufacturer’s name and model, and arrows indicating direction of flow shall be cast in raised characters and shall be clearly visible.

E. cover bolts and nuts shall be AISI Type 316 stainless steel.

F. Strainer cover shall be equipped with a vent screw to remove trapped air at installation.

2.10 WATER METER PROGRAMMING

A. All meters 50 mm or DN50 (2 inches) and above shall be programmable with software supplied by the meter manufacturer.

B. The software shall have a Microsoft based interface and operate on the latest Windows operating system. The software shall allow the user to configure the meter, troubleshoot the meter, query and display meter parameters, and configure data and stored values.

C. The meter firmware shall be upgradeable through one of the communication ports without removing the unit from service.

D. the meter shall include output for analog 4-20 milliamp signals and binary output.

E. The meter shall have two dry contact relays outputs for alarm or control functions.

F. The meter shall be equal to SCADAmetrics: EtherMeter SCADA/METER GATWAY suitable for Neptune Compound Meter.

2.11 WATER METER COMMUNICATION PROTOCOL

A. The meter shall use a native BACnet Ethernet communication protocol supporting Modbus and shall easily integrate with other modern SCADA systems . The communications shall be protected against surges induced on its communications channels..

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Install valve and snubber in piping for each pressure gage for fluids.

J. Install test plugs in piping tees.

K. Install thermometers in the following locations:

1. At inlet to emergency shower and eye wash station.

L. Install pressure gages in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.

B. Scale Range for Domestic Hot-Water Piping: 30 to 240 deg F.

3.5 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be one of the following:

1. Sealed, direct -mounted, metal case.
2. Test plug with EPDM self-sealing rubber inserts.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:

1. Sealed, direct -mounted, metal case.
2. Test plug with EPDM self-sealing rubber inserts.

C. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:

1. Sealed, direct -mounted, metal case.
2. Test plug with EPDM self-sealing rubber inserts.

3.6 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 200 psi.

B. Scale Range for Domestic Water Piping: 0 to 200 psi.

END OF SECTION 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1. 1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Iron, grooved-end butterfly valves.
4. Bronze swing check valves.
5. Iron, grooved-end swing check valves
6. Bronze gate valves.
7. Iron gate valves.
8. Lubricated plug valves.
9. Chainwheels.

B. Related Sections:

1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
2. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.
3. Section 221319 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.
4. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d)(13):

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

A. DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

a. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

b. Product Data: For each type of product.

c. Include construction details, material descriptions, dimension of individual components and profiles, and finishes.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

D. NSF Compliance: NSF 372 for 2014 Lead Free materials for potable water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5 Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1 Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.

5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. NIBCO INC.
   b. Kitz Corporation.
   c. Hammond Valve.

2. Description:

   a. Standard: MSS SP-110.
   b. SWP Rating: 150 psig.
   c. CWP Rating: 600 psig.
   d. Body Design: Two piece.
   e. Body Material: Forged brass
   f. Ends: Threaded.
   g. Seats: PTFE or TFE.
   h. Stem: Brass.
   i. Ball: Chrome-plated brass.
   j. Port: Full.

B. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Hammond Valve.
   b. Kitz Corporation.
   c. NIBCO, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Forged brass
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hammond Valve
b. NIBCO INC.
c. Red-White Valve Corporation.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass
j. Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. NIBCO INC.
c. Hammond Valve.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented
j. Port: Full.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Conbraco Industries, Inc.; Apollo Valves.
   b. Hammond Valve.
   c. Kitz Corporation.

2. Description:

   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 200 psig.
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
   e. Seat: EPDM.
   f. Stem: One- or two-piece stainless steel.
   g. Disc: Aluminum bronze.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Kitz Corporation.
   b. Hammond Valve
   c. Conbraco Industries, Inc.; Apollo Valves.

2. Description:

   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 200 psig.
   c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
   d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
   e. Seat: EPDM.
   f. Stem: One- or two-piece stainless steel.
   g. Disc: Nickel-plated or -coated ductile iron.

2.5 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Anvil International.
   b. Victaulic Company
   c. Tyco Fire Products LP; Grinnell Mechanical Products.

   .

2. Description:

   a. Standard: MSS SP-67, Type I.
   b. CWP Rating: 175 psig.
   c. Body Material: Coated, ductile iron
   d. Stem: Two-piece stainless steel.
   e. Disc: Coated, ductile iron.
   f. Seal: EPDM.

B. 300 CWP, Iron, Grooved-End Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Anvil International, Inc.
   b. Victaulic Company.
   c. Tyco Fire Products LP; Grinnell Mechanical Products..

2 Description:

   a. Standard: MSS SP-67, Type I.
   b. NPS 8 and Smaller CWP Rating: 300 psig.
   c. NPS 10 and Larger CWP Rating: 200 psig.
   d. Body Material: Coated, ductile iron.
   e. Stem: Two-piece stainless steel.
   f. Disc: Coated, ductile iron.
   g. Seal: EPDM.

2. 6 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Hammond Valve.
   b. Kitz Corporation.
   c. NIBCO INC.

2. Description:

   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 200 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze
   e. Ends: Threaded.
   f. Disc: Bronze.

B. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Kitz Corporation.
   b. Milwaukee Valve Company.
   c. NIBCO INC.

2. Description:

   a Standard: MSS SP-80, Type 3.
   b. CWP Rating: 300 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded.
   f. Disc: Bronze.

2. 7 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hammond Valve.

b. Kitz Corporation.

c. NIBCO INC.

2. Description:

a. Standard: MSS SP-71, Type I.

b. CWP Rating: 200 psig.

c. Body Design: Clear or full waterway.

d. Body Material: ASTM A 126, gray iron with bolted bonnet.

e. Ends: Flanged.

f. Trim: Bronze.

g. Gasket: Asbestos free.

B. Class 250, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hammond Valve.

b. Milwaukee Valve Company.

c. NIBCO INC.

2. Description:

a. Standard: MSS SP-71, Type I.

b. CWP Rating: 500 psig.

c. Body Design: Clear or full waterway.

d. Body Material: ASTM A 126, gray iron with bolted bonnet.

e. Ends: Flanged.

f. Trim: Bronze.

g. Gasket: Asbestos free.

2.8 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc.

b. Tyco Fire Products LP; Grinnell Mechanical Products.

c. Victaulic Company.

2. Description:

a. CWP Rating: 300 psig.

b. Body Material: ASTM A 536, ductile iron.

c. Seal: EPDM.

d. Disc: Spring-operated, ductile iron or stainless steel.

2. 9 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hammond Valve.

b. Kitz Corporation.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

B Class 125, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hammond Valve. Hammond Valve.
b. Kitz Corporation. Kitz Corporation.
d. NIBCO INC. NIBCO INC.

2 Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig.
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

C. Class 150, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products

a. Hammond Valve.
b. Kitz Corporation.
c. NIBCO INC.

that may be incorporated into the Work include, but are not limited to, the following:

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

D. Class 150, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hammond Valve.
b. Kitz Corporation.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

2.10 IRON GATE VALVES

A Class 125, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hammond Valve.
b. Kitz Corporation.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

B. Class 125, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hammond Valve.
b. Kitz Corporation.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-70, Type I.

b. CWP Rating: 200 psig.

c. Body Material: ASTM A 126, gray iron with bolted bonnet.

d. Ends: Flanged.

e. Trim: Bronze.

f. Disc: Solid wedge.

g. Packing and Gasket: Asbestos free.

C. Class 250, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Crane Co.; Crane Valve Group; Crane Valves.

b. Crane Co.; Crane Valve Group; Stockham Division.

c. NIBCO INC.

2. Description:

a. Standard: MSS SP-70, Type I.

b. CWP Rating: 500 psig.

c. Body Material: ASTM A 126, gray iron with bolted bonnet.

d. Ends: Flanged.

e. Trim: Bronze.

f. Disc: Solid wedge.

g. Packing and Gasket: Asbestos free.

D. Class 250, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hammond Valve.

b. Milwaukee Valve Company.

c. NIBCO INC.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 500 psig.
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

2.11 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Nordstrom Valves, Inc.

b. Home Stead

c. Link Seal

2. Description:

a. Standard: MSS SP-78, Type II.

b. CWP Rating: 200 psig.

c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication- sealing system.

d. Pattern: Regular or short.

e. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Nordstrom Valves, Inc.

b. Homestead Valve .

c. AES Valves.

2. Description:

a. Standard: MSS SP-78, Type II.

b. CWP Rating: 200 psig.

c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication- sealing system.

d. Pattern: Regular or short.

e. Plug: Cast iron or bronze with sealant groove.

C. Class 125, Cylindrical, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Homestead Valve; a division of Olson Technologies, Inc.

b. Milliken Valve Company.

c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:

a. Standard: MSS SP-78, Type IV.

b. CWP Rating: 200 psig.

c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication- sealing system.

d. Pattern: Regular or short .

e. Plug: Cast iron or bronze with sealant groove.

D. Class 125, Cylindrical, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Homestead Valve; a division of Olson Technologies, Inc.

b. Milliken Valve Company.

c. R & M Energy Systems; a unit of Robbins & Myers, Inc.

2. Description:

a. Standard: MSS SP-78, Type IV.

b. CWP Rating: 200 psig.

c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication- sealing

system.

d. Pattern: Regular or short.

e. Plug: Cast iron or bronze with sealant groove.

2.12 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Attachment: For connection to ball butterfly and plug valve stems.
3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc coating.
4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for ball butterfly gate and plug valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final

adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly , gate, or plug valves.
2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
3. Pump-Discharge Check Valves:
   a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
   b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal -seat check valves.
   c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve- end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, brass or bronze with brass stainless-steel trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Gate Valves: Class 125, RS.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves: Class 150.
3. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
4. Iron, Grooved-End Butterfly Valves: 175 CWP.
5. Iron Swing Check Valves: Class 125, metal seats
6. Iron, Grooved-End Swing Check Valves: 300 CWP.
7. Iron Gate Valves: , NRS OS&Y.

3.6 SANITARY-WASTE VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, brass or bronze with brass bronze stainless-steel trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Gate Valves: Class 125, RS.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Ball Valves: Class 150.
3. Iron Swing Check Valves: Class 125, metal seats.
4. Iron, Grooved-End Swing Check Valves: 300 CWP.
5. Iron Gate Valves: Class 125, NRS .

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Pipe positioning systems.
10. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.
4. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d) (13):
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.4 DEFINITIONS

A MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.5 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7 .

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.6 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1. Include construction details, material descriptions, dimension of individual components and profiles, and finishes..

C. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

D. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.7 INFORMATIONAL SUBMITTALS

A Welding certificates.

1.8 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 – PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Unistrut Corporation; Tyco International, Ltd
   b. Cooper B-Line, Inc.
   c. Thomas & Betts Corporation.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Hot-dipped galvanized.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Anvil International; a subsidiary of Mueller Water Products Inc
   b. Empire Industries, Inc.
   c. NIBCO INC
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.

5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Hot-dipped galvanized.

2.4 THERMAL-HANGER SHIELD INSERTS

A Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carpenter & Paterson, Inc.
2. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc
3. ERICO International Corporation.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Plastic.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous- thread rods.

4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless- steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural- steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon- steel shapes.

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 – EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.

F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

H. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

I. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

M. Install lateral bracing with pipe hangers and supports to prevent swaying.

N. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

O. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

Q. Insulated Piping:

1. Attach clamps and spacers to piping.
   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   A. Option: Thermal-hanger shield inserts may be used. Include steel weight- distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
   a. Option: Thermal-hanger shield inserts may be used. Include steel weight- distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

D. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off- center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.

7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel- pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS ¾ to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I- beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I- beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1- 1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
   a. Horizontal (MSS Type 54): Mounted horizontally.
   b. Vertical (MSS Type 55): Mounted vertically.
   c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220533 - HEAT TRACING FOR PLUMBING PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes plumbing piping heat tracing for freeze prevention, domestic hot-water-temperature maintenance, and snow and ice melting on roofs and in gutters and downspouts with the following electric heating cables:

1. Plastic insulated, series resistance.
2. Self-regulating, parallel resistance.
3. Constant wattage.

B. Related Requirements:

1. Section 210533 "Heat Tracing for Fire-Suppression Piping."
2. Section 230533 "Heat Tracing for HVAC Piping."
3. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d) (13):
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimension of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
3. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.

C. Shop Drawings: For electric heating cable.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For heat tracing for plumbing piping to include in the operation and maintenance manuals specified in form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For heat tracing for plumbing piping specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. BriskHeat.
2. Chromalox.
3. Raychem; a brand of Tyco Thermal Controls LLC.

B. Comply with IEEE 515.1.

C. Heating Element: Pair of parallel No. 16 AWG, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

D. Electrical Insulating Jacket: Flame-retardant polyolefin.

E. Cable Cover: Tinned-copper braid and polyolefin outer jacket with ultraviolet inhibitor.

F. Maximum Operating Temperature (Power On): 150 deg F.

G. Maximum Exposure Temperature (Power Off): 185 deg F.

H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

I. Capacities and Characteristics:

1. Maximum Heat Output: 5 W/ft.
2. Piping Diameter: As indicated.
3. Number of Parallel Cables: Two.
4. Spiral Wrap Pitch: Per Manufactures recommendations.
5. Electrical Characteristics for Single-Circuit Connection:
   a. Volts: 480.

b. Phase: single.

c. Hertz: 60

d. Full-Load Amperes: As indicated.

e. Minimum Circuit Opacity: As indicated

f. Maximum Over current Protection: As indicated.

2.2 CONTROLS

A. Pipe-Mounted Thermostats for Freeze Protection:

1. Remote bulb unit with adjustable temperature range from 30 to 50 deg F.

2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.

3. Remote bulb on capillary, resistance temperature device, or thermostat for directly sensing pipe-wall temperature.

4. Corrosion-resistant, waterproof NEMA 4 control enclosures. Enclosures shall include heat trace power distribution, ground-fault protection, individual circuit alarming, line and ambient sensing control.

2.3 ACCESSORIES

A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

B. Warning Labels: Refer to Section 220553 "Identification for Plumbing Piping and Equipment."

D. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, and Less Than 6 Inches: 3/4 inch minimum.

2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.

1 Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONSINSTALLATION

A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.

B. Electric Heating-Cable Installation for Freeze Protection for Piping:

1. Install electric heating cables after piping has been tested and before insulation is installed.
2. Install electric heating cables according to IEEE 515.1.
3. Install insulation over piping with electric cables according to Section 220719 "Plumbing Piping Insulation."
4. Install warning tape on piping insulation where piping is equipped with electric heating cables.

C. Set field-adjustable switches and circuit-breaker trip ranges.

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
2. Test cables for electrical continuity and insulation integrity before energizing.
3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

D. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.

E. Cables will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 PROTECTION

A. Protect installed heating cables, including non-heating leads, from damage during construction.

B. Remove and replace damaged heat-tracing cables.

END OF SECTION 220533

SECTION 220548.13 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Elastomeric hangers.
11. Spring hangers.

B. Related Requirements:

1. Section 210548.13 "Vibration Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 230548.13 "Vibration Controls for HVAC" for devices for HVAC equipment and systems.
3. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d) (13):
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

C. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and

attachments to structure and to supported equipment.

D. Calculations prepared by a State of CT, professional engineer for Delegated-Design Submittal: For each vibration isolation device.

1. Include design calculations for selecting vibration isolators.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For testing agency.

C. Welding certificates.

D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 – PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Kinetics Noise Control, Inc.
b. Mason Industries, Inc.
c. Vibration Eliminator Co., Inc.

2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.

3. Size: Factory or field cut to match requirements of supported equipment.

4. Pad Material: Oil and water resistant with elastomeric properties.

5. Surface Pattern: Waffle pattern.

6. Infused nonwoven cotton or synthetic fibers.

7. Load-bearing metal plates adhered to pads.

8. Sandwich-Core Material: Resilient and elastomeric.

a. Surface Pattern: Waffle pattern.

b. Infused nonwoven cotton or synthetic fibers.

2.2 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Kinetics Noise Control, Inc.
    b. Mason Industries, Inc.
    c. Vibration Eliminator Co., Inc.
2. Mounting Plates:
    a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
    b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts: .
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Kinetics Noise Control, Inc.
    b. Mason Industries, Inc.
    c. Vibration Eliminator Co., Inc.
2. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
    a. Housing: Cast-ductile iron or welded steel.
    b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators: .
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Kinetics Noise Control, Inc.
    b. Mason Industries, Inc.
    c. Vibration Eliminator Co., Inc.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.5 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Kinetics Noise Control, Inc.
   b. Mason Industries, Inc.
   c. Vibration Eliminator Co., Inc.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
   a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
   b. Top housing with attachment and leveling bolt.

2.6 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Kinetics Noise Control, Inc
   b. Mason Industries, Inc.
   c. Vibration Eliminator Co., Inc.
2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
   a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
   b. Top plate with threaded mounting holes.
   c. Internal leveling bolt that acts as blocking during installation.
3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.7 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Isolation Technology, Inc.

2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.

   b. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.

   c. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.8 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- thick neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.

2. Maximum Load Per Support: 500 psigon isolation material providing equal isolation in all directions.

2.9 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- thick neoprene.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.10 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Ace Mountings Co., Inc.
   b. California Dynamics Corporation.
   c. Isolation Technology, Inc.

2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger- rod misalignment

without binding or reducing isolation efficiency.

3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.11 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Kinetics Noise Control, Inc.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION CONTROL DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

END OF SECTION 220548.13

SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
7. Housed-restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Elastomeric hangers.
11. Spring hangers.
12. Snubbers.
13. Restraint channel bracings.
14. Restraint cables.
15. Seismic-restraint accessories.
16. Mechanical anchor bolts.
17. Adhesive anchor bolts.

B. Related Requirements:

1. Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment" for devices for fire-suppression equipment and systems.
2. Section 230548 "Vibration and Seismic Controls for HVAC" for devices for HVAC equipment and systems.

C. RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d)(13):
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning & Development (for the State of Connecticut).

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimension of individual components and profiles, and finishes.
2. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
   b. Annotate to indicate application of each product submitted and compliance with requirements.
4. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

C. Shop Drawings:

1 Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

D. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.

1. Include design calculations and details for selecting vibration isolators and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified State of CT professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select vibration isolators, and due to seismic restraints.
3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
4. Seismic-Restraint Details:
   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
   d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Field quality-control reports.

1.7 QUALITY ASSURANCE SUBMITTALS:

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic- restraint designs must be signed and sealed by a qualified professional engineer.

E. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

PART 2 – PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: D.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC III.
   a. Component Importance Factor: 1.0.
   b. Component Response Modification Factor: 1.5.
   c. Component Amplification Factor: 2.5.
3. Design Spectral Response Acceleration at Short Periods : See drawing S100.
4. Design Spectral Response Acceleration at 1.0-Second Period: See drawing S100.
5. Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Kinetics Noise Control, Inc.
   b. Mason Industries, Inc.
   c. Vibration Eliminator Co., Inc.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Waffle pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.8. Sandwich-Core Material: Resilient and elastomeric.
   a. Surface Pattern: Waffle pattern.
   b. Infused nonwoven cotton or synthetic fibers.

2.3 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Kinetics Noise Control, Inc.
   b. Mason Industries, Inc.
   c. Vibration Eliminator Co., Inc.
2. Mounting Plates:
   a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded.
   b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Kinetics Noise Control, Inc.
   b. Mason Industries, Inc.
   c. Vibration Eliminator Co., Inc.
4. Description: All-directional isolator with seismic restraints containing two separate and opposing

elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

a. Housing: Cast-ductile iron or welded steel.

b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.5 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Kinetics Noise Control, Inc.
   b. Mason Industries, Inc.
   c. Vibration Eliminator Co., Inc.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig (3447 kPa).

7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.6 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Kinetics Noise Control, Inc.

   b. Mason Industries, Inc.

   c. Vibration Eliminator Co., Inc.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.

   a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).

b. Top housing with attachment and leveling bolt.

2.7 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Kinetics Noise Control, Inc.

b. Mason Industries, Inc.

c. Vibration Eliminator Co., Inc.

2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).

b. Top plate with threaded mounting holes.

c. Internal leveling bolt that acts as blocking during installation.

3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.

4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

5. Minimum Additional Travel: 50 percent of the required deflection at rated load.

6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.8 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Kinetics Noise Control, Inc.
b. Mason Industries, Inc.
c. Vibration Eliminator Co., Inc.

2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.

a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).

b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.9 PIPE-RISER RESILIENT SUPPORT

A Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- (13-mm-) thick neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
2. Maximum Load Per Support: 500 psig (3.45 MPa) on isolation material providing equal isolation in all directions.

2.10 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- (13-mm-) thick neoprene.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.11 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Kinetics Noise Control, Inc.
   b. Mason Industries, Inc.
   c. Vibration Eliminator Co., Inc.
2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger- rod misalignment without binding or reducing isolation efficiency.
3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.12 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Kinetics Noise Control, Inc.
   b. Mason Industries, Inc.
   c. Vibration Eliminator Co., Inc.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.
10. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
11. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
12. Minimum Additional Travel: 50 percent of the required deflection at rated load.
13. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
14. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
15. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
16. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
17. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.13 SNUBBERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Kinetics Noise Control, Inc.
   2. Mason Industries, Inc.
   3. Vibration Mountings & Controls, Inc.

B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
   1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
   2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
   3. Maximum 1/4-inch (6-mm) air gap, and minimum 1/4-inch- (6-mm-) thick resilient cushion.

2.14 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may

be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Mason Industries, Inc.
3. Unistrut.

C. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.15 RESTRAINT CABLES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Kinetics Noise Control, Inc.
2. Loos & Co., Inc.
3. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A 492 stainless-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.16 SEISMIC-RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper B-Line, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.17 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hilti, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

D. Equipment Restraints:

1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

E. Piping Restraints:

1. Comply with requirements in MSS SP-127.

2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
3. Brace a change of direction longer than 12 feet (3.7 m).

F. Install cables so they do not bend across edges of adjacent equipment or building structure.

G. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

I. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

J. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

K. Drilled-in Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 221116 "Domestic Water Piping" for piping flexible connections.

3. 5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:
1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities

having jurisdiction.

2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least **[four]** of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

END OF SECTION 220548

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d)(13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1. Include construction details, material description, dimensions of individual components and profiles, and finishes.

C. Samples: For color, letter style, and graphic representation required for each identification material and device.

D. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

E. Valve numbering scheme.

F. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For identification for plumbing piping and equipment to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where

devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 – PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Yellow .

C. Background Color: Blue .

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, ½ inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover, cover full, circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.

2. Lettering Size: At least 1-1/2 incheshigh.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Aluminum**.**

2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.

3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

1.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2- inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

1.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.

2. Fasteners: Brass grommet and wire.

3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT

OPERATE."

4. Color: Yellow background with black lettering.

PART 3 – EXECUTION

3.1 PREPARATION

1. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Domestic Water Piping:
   a. Background Color: Blue.
   b. Letter Color: White.
2. Sanitary Waste and Storm Drainage Piping:
   a. Background Color: Green.
   b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:
   a. Cold Water: 1-1/2 inches, round.
   b. Hot Water: 1-1/2 inches, round.
2. Valve-Tag Color:
   a. Cold Water: Natural.
   b. Hot Water: Natural.
3. Letter Color:
   a. Cold Water: Black.
   b. Hot Water: Black.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Domestic cold-water piping.
2. Domestic hot-water piping.
3. Sanitary waste piping exposed to freezing conditions.
4. Storm-water piping exposed to freezing conditions.
5. Roof drains and rainwater leaders.
6. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation."
2. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d)(13):
3. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes..

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

1. Detail attachment and covering of heat tracing inside insulation.
2. Detail insulation application at pipe expansion joints for each type of insulation.
3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
4. Detail removable insulation at piping specialties, equipment connections, and access panels.
5. Detail application of field-applied jackets.
6. Detail application at linkages of control devices.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
2. Jacket Materials for Pipe: 12 inches long by NPS 2.
3. Sheet Jacket Materials: 12 inches square.
4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

D. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.8 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.9 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 – PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Micro-Lok.

b. Knauf Insulation; 1000-Degree Pipe Insulation.

c. Manson Insulation Inc.; Alley-K.

2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory- applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.

b. Eagle Bridges - Marathon Industries; 225.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.

b. Eagle Bridges - Marathon Industries; 225.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.

b. P.I.C. Plastics, Inc.; Welding Adhesive.

c. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 SEALANTS

A. Joint Sealants:

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

b. Eagle Bridges - Marathon Industries; 405.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Brands
c. Foster Products
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

2.5 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.

c. Proto Corporation; LoSmoke.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. ABI, Ideal Tape Division; 428 AWF ASJ.
      b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
      c. .Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   2. Width: 3 inches.
   3. Thickness: 11.5 mils.
   4. Adhesion: 90 ounces force/inch in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. ABI, Ideal Tape Division; 370 White PVC tape.
      b. Compac Corporation; 130.
      c. Venture Tape; 1506 CW NS.
   2. Width: 2 inches.
   3. Thickness: 6 mils.
   4. Adhesion: 64 ounces force/inch in width.
   5. Elongation: 500 percent.
   6. Tensile Strength: 18 lbf/inch in width.

2.7 SECUREMENTS

A. Bands:
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. ITW Insulation Systems; Gerrard Strapping and Seals.

b. RPR Products, Inc.; Insul-Mate Strapping and Seals.

c. Compac Corporation; 104 and 105

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 ; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.

2.8 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers, :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Truebro a brand of IPS Corporation.

b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.

c. McGuire manufacturing.

3. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold- water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures, :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Truebro; a brand of IPS Corporation.

b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

c. Proto Corporation

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold- water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.

2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an

epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3. 3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at

bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c. a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through

penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless- steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.8 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3. 9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be the following:

a Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

2. NPS 1-1/4 and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:

1. NPS 1-1/4 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. NPS 1-1/2 and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Domestic Chilled Water (Potable):

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

D. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

E. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: thick.

F. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

G. Sanitary Waste Piping Where Heat Tracing Is Installed:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

H. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.

I. Hot Service Drains:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

J. Hot Service Vents:

1. All Pipe Sizes: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. PVC: 30 mils thick.

2. In bus washing area and fuel dispensing area: Stainless Steel, Finish: 0.024 inch thick.

3. In lubrication rooms: Stainless Steel, Type 304, Smooth 2B Finish.

3.13 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220719

SECTION 220800 – COMMISSIONING OF PLUMBING

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Notice to Contractor Sections, apply to this Section. Refer to NOTICE TO CONTRACTOR – COMMISSIONING for a full description of the commissioning process and requirements.

1.2. SUMMARY

A. Commissioning consists of systematically documenting that specified components and systems have been installed and started up properly and then functionally tested to verify and document proper operation through all sequences of operation and conditions. In addition, training of the Owner's Operations Personnel will be verified and final project O&M Documents will be reviewed for completeness.

PART 2 – PRODUCTS

2.1. FUNCTIONAL PERFORMANCE TESTING EQUIPMENT AND INSTRUMENTS

A. Contractor shall provide all tools, instruments, laptop computers, PDA's, software programs and services required to perform system Functional Performance Testing procedures. This includes providing the connection to systems to be tested, operation of the test equipment & instrumentation and generating test results as required.

PART 3 – EXECUTION

3.1. FUNCTIONAL PERFORMANCE TESTING

A. The contractor shall demonstrate to the Engineer and the Cx Authority the performance of the following Plumbing Systems to the performance level identified.

1. Sewage Ejector Pumping System:

   a. System / Equipment to be tested:
      1) Ejector Pumps
      2) Controls

   b. Functions to be tested:
      1) Level control
      2) Discharge functionality

c. Conditions of the test:
   1) System in normal operational condition.

d. Acceptance criteria:
   1) System discharges sewage as designed

2. Domestic Hot Water System:

a. System / Equipment to be tested:
   1) Domestic Water Heaters
   2) Circulating Pumps
   3) Mixing Valves

b. Functions to be tested:
   1) Water temperature recovery at unit
   2) Water temperature and heating time at selected plumbing fixtures

c. Conditions of the test:
   1) System in normal operational condition.

d. Acceptance criteria:
   1) System heats water as designed

END OF SECTION 220800

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.
2. Encasement for piping.

B. RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(d) (13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

1. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

PART 2 – PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:
   1. MSS SP-123.
   2. Cast-copper-alloy, hexagonal-stock body.
   3. Ball-and-socket, metal-to-metal seating surfaces.
   4. Solder-joint or threaded ends.

G. Copper Pressure-Seal-Joint Fittings:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Elkhart Products Corporation.
      b. NIBCO Inc.
      c. Viega.
   2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
   3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM- rubber, O-ring seal in each end.

H. Appurtenances for Grooved-End Copper Tubing:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Anvil International.
      b. Shurjoint Piping Products.
      c. Victaulic Company.
   2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings.
   3. Mechanical Couplings for Grooved-End Copper Tubing:
      a. Copper-tube dimensions and design similar to AWWA C606.
      b. Ferrous housing sections.
      c. EPDM-rubber gaskets suitable for hot and cold water.
      d. Bolts and nuts.
      e. Minimum Pressure Rating: 300 psig.

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:
   1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
   2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:
   1. AWWA C110/A21.10, ductile or gray iron.
   2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

1. AWWA C 153/A21.53, ductile iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Push-on-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51.
2. Push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

E. Standard-Pattern, Push-on-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Gaskets: AWWA C111/A21.11, rubber.

F. Compact-Pattern, Push-on-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Gaskets: AWWA C111/A21.11, rubber.

G. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

H. Appurtenances for Grooved-End, Ductile-Iron Pipe:

1. Manufacturers: Subject to compliance with requirements, [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   a. Shurjoint Piping Products.
   b. Star Pipe Products.
   c. Victaulic Company.
2. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions that match pipe. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:
   a. AWWA C606 for ductile-iron-pipe dimensions.
   b. Ferrous housing sections.
   c. EPDM-rubber gaskets suitable for hot and cold water.
   d. Bolts and nuts.
   e. Minimum Pressure Rating: 175 psig.

2.4 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: Black or natural.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Jomar International.

b. Watts; a division of Watts Water Technologies, Inc.

c. Wilkins; a Zurn company.

2. Standard: ASSE 1079.

3. Pressure Rating: 150 psig.

4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Jomar International.

b. Watts; a division of Watts Water Technologies, Inc.

c. Wilkins: a Zurn Company.

2. Standard: ASSE 1079.

3. Factory-fabricated, bolted, companion-flange assembly.

4. Pressure Rating: 150 psig.

5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Advance Products & Systems, Inc.

b. Central Plastics Company.

c. Pipeline Seal and Insulator, Inc.

2. Nonconducting materials for field assembly of companion flanges.

3. Pressure Rating: 150 psig.

4. Gasket: Neoprene or phenolic.

5. Bolt Sleeves: Phenolic or polyethylene.

6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Grinnell Mechanical Products; Tyco Fire Products LP.
    b. Precision Plumbing Products, Inc.
    c. Victaulic Company.
2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F .
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 300000 "Earth Moving" for excavating, trenching, and backfilling as part of the MLSI No. 0100150A for payment.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

H. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

I. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

L. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

N. Install piping to permit valve servicing.

O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

P. Install piping free of sags and bends.

Q. Install fittings for changes in direction and branch connections.

R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

S. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten

housing bolts.

H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric .

C. Dielectric Fittings for NPS 2-1/2 to NPS 4 : Use dielectric flange kits .

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3. 9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:
   a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
      2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.

2. Open shutoff valves to fully open position.

3. Open throttling valves to proper setting.

4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.

b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.

6. Remove and clean strainer screens. Close drain valves and replace drain plugs.

7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.

8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:
      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
   c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
   d. Repeat procedures if biological examination shows contamination.
   e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water- sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller , shall be the following:

1 Soft copper tube, ASTM B 88, Type K ; wrought-copper, solder-joint fittings; and brazed copper pressure-seal fittings; and pressure-sealed joints.

E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger , shall be one of the following:

1. Soft copper tube, ASTM B 88, Type K ; wrought-copper, solder-joint fittings; and brazed joints.
2. Mechanical-joint, ductile-iron pipe; standard- pattern, mechanical-joint fittings; and mechanical joints.
3. Push-on-joint, ductile-iron pipe; standard- pattern, push-on-joint fittings; and gasketed joints.

F. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12 , shall be one of the following:
1. Mechanical-joint, ductile-iron pipe; standard- pattern, mechanical-joint fittings; and mechanical joints.
2. Push-on-joint, ductile-iron pipe; standard- pattern, push-on-joint fittings; and gasketed joints.
3. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

G. Under-building-slab, domestic water piping, NPS 2 and smaller , shall be the following:
1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and brazed copper pressure-seal-joint fittings; and pressure-sealed joints.

H. Aboveground domestic water piping, NPS 2 and smaller , shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L ; cast- or wrought-copper, solder-joint fittings; and soldered joints.
2. Hard copper tube, ASTM B 88, Type L ; copper pressure-seal-joint fittings; and pressure-sealed joints.

I. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 , shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L ; cast- or wrought-copper, solder-joint fittings; and brazed joints.
2. Hard copper tube, ASTM B 88, Type L ; copper pressure-seal-joint fittings; and pressure-sealed joints.
3. Hard copper tube, ASTM B 88, Type L ; grooved-joint, copper-tube appurtenances; and grooved joints.
4. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
3. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

SECTION 221117 - NATURAL GAS PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials
4. Valves.
5. Pressure regulators.
6. Service meters.
7. Energy data meters.
8. Concrete bases.

B. Related Sections

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d)(13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 DEFINITIONS

B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

C. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

D. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.
3. Minimum Operating Pressure of Service Meter: 10 psig .

B. Natural-Gas System Pressure within Buildings: More than 0.5 psig but not more than 2 psig.

C. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig and is reduced to secondary pressure of 0.5 psig or less.

D. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified State of CT professional engineer, using performance requirements and design criteria indicated.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR SUBMITTALS.

B. Product Data: For each type of the following product:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes
2. Piping specialties.
3. Corrugated, stainless-steel tubing with associated components.
4. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
5. Pressure regulators. Indicate pressure ratings and capacities.
6. Service meters. Indicate[pressure ratings and capacities. Include bypass fittings and meter bars.
7. Dielectric fittings.

E. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1. Shop Drawing Scale: 1/4 inch per foot.
2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.

F. Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified State of CT professional engineer responsible for their preparation.

1. Detail fabrication and assembly of seismic restraints.
2. Design Calculations: Calculate requirements for selecting seismic restraints.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

B. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

C. Qualification Data: For qualified professional engineer.

D. Welding certificates.

E. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For natural gas piping to include in the operation and maintenance manuals specified in form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.8 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.10 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

1.1 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 083113 "Access Doors and Frames."

PART 2 – PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

a. Material Group: 1.1.

b. End Connections: Threaded or butt welding to match pipe.

c. Lapped Face: Not permitted underground.

d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.

e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

6. Mechanical Couplings:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Dresser Piping Specialties; Division of Dresser, Inc.

2) Smith-Blair, Inc.

3) Topaz

b. Stainless-steel flanges and tube with epoxy finish.

c. Buna-nitrile seals.

d. Stainless-steel bolts, washers, and nuts.

e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.

f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.

2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.

3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.

4. Corrugated stainless-steel tubing with polymer coating.

5. Operating-Pressure Rating: 0.5 psig.

6. End Fittings: Zinc-coated steel.

7. Threaded Ends: Comply with ASME B1.20.1.

8. Maximum Length: 72 inches.

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.

2. Nitrile seals.

3. Hand operated with automatic shut off when disconnected.

4. For indoor or outdoor applications.

5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40]-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig .

D. Basket Strainers:
1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40 -mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

E. T-Pattern Strainers:
1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40 -mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig.

F. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.3 JOINING MATERIALS

A. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

B. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
1. CWP Rating: 125 .
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4) to NPS shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. BrassCraft Manufacturing Company; a Masco company.
   b. Conbraco Industries, Inc.; Apollo Div.
   c. Lyall, R. W. & Company, Inc.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. BrassCraft Manufacturing Company; a Masco company.
   b. Conbraco Industries, Inc.; Apollo Div.
   c. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.

9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Bronze Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Lee Brass Company.
   b. McDonald, A. Y. Mfg. Co.
   c. DeZurik
2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. McDonald, A. Y. Mfg. Co.
   b. Mueller Co.; Gas Products Div.
   c. Xomox Corporation; a Crane company.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig (862 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

H. Valve Boxes:
1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches (125 mm) in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.

5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head and with stem of length required to operate valve.

2.5 EARTHQUAKE VALVES

A. Earthquake Valves: Comply with ASCE 25.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Pacific Seismic Products, Inc.
   b. Seismic Safety Products
   c. J. Beap Industries
2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
3. Maximum Operating Pressure:[0.5 psig .
4. Cast-aluminum body with stainless-steel internal parts.
5. Nitrile-rubber, reset-stem o-ring seal.
6. Valve position, open or closed, indicator.
7. Composition valve seat with clapper held by spring or magnet locking mechanism.
8. Level indicator.
9. End Connections: Threaded for valves NPS 2 and smaller; flanged for valves NPS 2-1/2 and larger.

2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel j acket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Service Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Meter Company.
   b. Fisher Control Valves and Regulators; Division of Emerson Process Management.
   c. Invensys.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet,

and no pressure sensing piping external to the regulator.

9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 100 psig.

C. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Actaris.
   b. American Meter Company.
   f. Maxitrol Company.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 5 psig.

D. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Eaton Corporation; Controls Div.
   b. Harper Wyman Co.
   c. Maxitrol Company.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.

7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 2 psig.

2.7 SERVICE METERS

A. Diaphragm-Type Service Meters: Comply with ANSI B109.1, ANSI B109.2.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Actaris.
   b. American Meter Company.
   c. Invensys.
2. Case: Die-cast aluminum.
3. Connections: Steel threads.
4. Diaphragm: Synthetic fabric.
5. Diaphragm Support Bearings: Self-lubricating.
6. Compensation: Continuous temperature and pressure.
7. Meter Index: Cubic feet..
8. Meter Case and Index: Tamper resistant.
9. Remote meter reader compatible.
10. Maximum Inlet Pressure: 100 psig
11. Pressure Loss: Maximum 0.5-inch wg
12. Accuracy: Maximum plus or minus 1.0 .

D. Service-Meter Bars:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   a. American Meter Company.
   b. Lyall, R. W. & Company, Inc.
   c. Mueller Co.; Gas Products Div.
2. Malleable- or cast-iron frame for supporting service meter.
3. Include offset swivel pipes, meter nuts with o-ring seal, and factory- or field-installed dielectric unions.
4. Omit meter offset swivel pipes if service-meter bar dimensions match service-meter connections.

E. Service-Meter Bypass Fittings:

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Lyall, R. W. & Company, Inc.
   b. Williamson, T. D., Inc.
   c. Mueller Co.; Gas Products Div
2. Ferrous, tee, pipe fitting with capped side inlet for temporary natural-gas supply.

3. Integral ball-check bypass valve.

2.8 ENERGY DATA METER

A. Turbine Meters: Comply with ASME MFC-4M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Meter Company.
   b. Invensys.
   c. Maxitrol
2. Housing: Cast iron or welded steel.
3. Connection Threads or Flanges: Steel.
4. Turbine: Aluminum or plastic.
5. Turbine Bearings: Self-lubricating.
6. Compensation: Continuous temperature and pressure.
7. Meter Index: Cubic feet.
8. Tamper resistant.
9. Remote meter reader compatible.
10. Maximum Inlet Pressure: 100 psig .
11. Accuracy: Maximum plus or minus 2.0 percent.

2.9 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Jomar International Ltd.
   b. Watts Regulator Co.; a division of Watts Water Technologies, Inc
   c. Wilkins; a Zurn company.
2. Description:
   a. Standard: ASSE 1079.
   b. Pressure Rating: 125 psig minimum at 180 deg F .
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

C Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Matco-Norca, Inc.
   b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   c. Wilkins; a Zurn company.
2. Description:

a. Standard: ASSE 1079.

b. Factory-fabricated, bolted, companion-flange assembly.

c. Pressure Rating: 125 psig minimum at 180 deg F

d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

C. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Advance Products & Systems, Inc.

b. Central Plastics Company.

c. Pipeline Seal and Insulator, Inc.

2. Description:

a. Nonconducting materials for field assembly of companion flanges.

b. Pressure Rating: 150 .

c. Gasket: Neoprene or phenolic.

d. Bolt Sleeves: Phenolic or polyethylene.

e. Washers: Phenolic with steel backing washers.

2.10 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 the International Fuel Gas Code for installation and purging of natural- gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with

requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Copper Tubing with Protective Coating:

1. Apply joint cover kits over tubing to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.

F. Install fittings for changes in direction and branch connections.

G. Install pressure gage upstream and downstream from each service regulator.

3.4 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 the International Fuel Gas Code] for installation and purging of natural- gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
   a. Exception: Tubing passing through partitions or walls does not require striker barriers.
5. Prohibited Locations:
   a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
   b. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. Install pressure gage upstream and downstream from each line regulator.

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.5 SERVICE-METER ASSEMBLY INSTALLATION

A. Install service-meter assemblies aboveground, on concrete bases.

B. Install metal shutoff valves upstream from service regulators. Shutoff valves are not required at second regulators if two regulators are installed in series.

C. Install strainer on inlet of service-pressure regulator and meter set.

D. Install service regulators mounted outside with vent outlet horizontal or facing down. Install screen in vent outlet if not integral with service regulator.

E. Install metal shutoff valves upstream from service meters. Install dielectric fittings downstream from service meters.

F. Install service meters downstream from pressure regulators.

G. Install metal bollards to protect meter assemblies. Comply with requirements in Section 055000 "Metal Fabrications" for pipe bollards.

3.6 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

3.7 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.

2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.8 HANGER AND SUPPORT INSTALLATION

A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 1 and Smaller: Maximum span, 96 inches ; minimum rod size, 3/8 inch.
2. NPS 1-1/4 : Maximum span, 108 inches ; minimum rod size, 3/8 inch .
3. NPS 1-1/2 and NPS 2 : Maximum span, 108 inches ; minimum rod size, 3/8 inch).
4. NPS 2-1/2 to NPS 3-1/2 : Maximum span, 10 feet ; minimum rod size, 1/2 inch .
5. NPS 4 and Larger: Maximum span, 10 feet ; minimum rod size, 5/8 inch .

3.9 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.10 LABELING AND IDENTIFYING

A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.

B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.11 PAINTING

A. Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.
   a. Prime Coat: Alkyd anticorrosive metal primer.
   b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
   c. Topcoat: Exterior alkyd enamel gloss.
   d. Color: Gray.

C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
   a. Prime Coat: Alkyd anticorrosive metal primer.
   b. Intermediate Coat: Interior latex matching topcoat.
   c. Topcoat: Interior latex low sheen eggshell.
   d. Color:Gray.
2. Alkyd System: MPI INT 5.1E.
   a. Prime Coat: Alkyd anticorrosive metal primer.
   b. Intermediate Coat: Interior alkyd matching topcoat.
   c. Topcoat: Interior alkyd gloss.
   d. Color: Gray.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.12 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Use 3000-psig , 28-day, compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."

3.13 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 the International Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.14 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.15 OUTDOOR PIPING SCHEDULE

A. Aboveground natural-gas piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

2. Steel pipe with wrought-steel fittings and welded joints.

B. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.16 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

2. Steel pipe with wrought-steel fittings and welded joints.

C. Underground, below building, piping shall be the following:

1. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.17 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG

A. Aboveground, branch piping NPS 1 and smaller shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

2. Steel pipe with steel welding fittings and welded joints.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat underground pipe

and fittings with protective coating for steel piping.

D. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.18 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be the following:

1. Cast-iron, nonlubricated plug valve.

C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:

1. Bronze plug valve.

D. Distribution piping valves for pipe sizes NPS 2-1/2 and larger shall be one of the following:

1. Cast-iron, nonlubricated plug valve.

E. Valves in branch piping for single appliance shall be one of] the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full -port, bronze ball valves with bronze trim.
3. Bronze plug valve.

END OF SECTION 221117

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves
6. Strainers.
7. Hose stations.
8. Hose bibbs.
9. Wall hydrants.
10. Post hydrants.
11. Drain valves.
12. Water-hammer arresters.
13. Air vents.
14. Trap-seal.
15. Specialty valves.
16. Flexible connectors.

B. Related Requirements:

1. Section 220519 "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 224500 "Emergency Plumbing Fixtures" for water tempering equipment.
4. Section 224713 "Drinking Fountains" for water filters for water coolers.
5. Section 224716 "Pressure Water Coolers" for water filters for water coolers.

C. RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d)(13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR-SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For domestic water piping specialties to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. FEBCO; a division of Watts Water Technologies, Inc.

b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1001.

3. Size: NPS 1/4 to NPS 3, as required to match connected piping.

4. Body: Bronze.

5. Inlet and Outlet Connections: Threaded.

6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

b. Woodford Manufacturing Company; a division of WCM Industries, Inc.

c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products

2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B 1.20.7.
5. Finish: Chrome or nickel plated.

B. Spill-Resistant Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Conbraco Industries, Inc.
b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
c. Woodford Manufacturing Company; a division of WCM Industries, Inc.
2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2 .
5. Accessories:
a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers :
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. FEBCO; a division of Watts Water Technologies, Inc.
b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/2 NPS 3/4.
5. Body: Bronze.
6. End Connections: Union, solder joint.
7. Finish: Chrome plated .

B. Reduced-Pressure-Principle Backflow Preventers :
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. FEBCO; a division of Watts Water Technologies, Inc.
b. Flomatic Corporation.
c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 10 psig maximum, through middle third of flow range.
5. Size

6. Design Flow Rate.
7. Selected Unit Flow Range Limits: .
8. Pressure Loss at Design Flow Rate: 8 psig for sizes NPS 2 and smaller; 10 psig for NPS 2-1/2 and larger.
9. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
11. Configuration: Designed for horizontal, straight-through vertical flow.
12. Accessories:
    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check, Backflow-Prevention Assemblies :
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
    b. Conbraco Industries, Inc.
    c. FEBCO; a division of Watts Water Technologies, Inc.
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Size.
6. Design Flow Rate: .
7. Selected Unit Flow Range Limits: .
8. Pressure Loss at Design Flow Rate: 6 psig for sizes NPS 2 and smaller; 8 psig for NPS 2- 1/2 and larger.
9. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
11. Configuration: Designed for horizontal, straight-through flow.
12. Accessories:
    a. ValvesNPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. ValvesNPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

D. Beverage-Dispensing-Equipment Backflow Preventers :
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Conbraco Industries, Inc.
    b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

2. Standard: ASSE 1022.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 or NPS 3/8.
5. Body: Stainless steel.
6. End Connections: Threaded.

E. Double-Check, Detector-Assembly Backflow Preventers :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. FEBCO; a division of Watts Water Technologies, Inc.
   b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1048 and is FM Global approved or UL listed.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Size.
6. Design Flow Rate: .
7. Selected Unit Flow Range Limits.
8. Pressure Loss at Design Flow Rate: 8 psig.
9. Body: Cast iron with interior lining that complies with AWWA C550 or that is FDA approved .
10. End Connections: Flanged.
11. Configuration: Designed for horizontal, straight-through vertical flow.
12. Accessories:
    a. Valves: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

F. Hose-Connection Backflow Preventers :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Conbraco Industries, Inc.
   b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   c. Woodford Manufacturing Company; a division of WCM Industries, Inc.
2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Cash Acme; a division of Reliance Worldwide Corporation.
    b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
5. Valves for Booster Heater Water Supply: Include integral bypass.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Leonard Valve Company.
    b. Powers; a division of Watts Water Technologies, Inc.
    c. Symmons Industries, Inc.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature- control handle.
8. Tempered-Water Setting: 2110 °F.
9. Tempered-Water Design Flow Rate: .
10. Valve Finish: Chrome plated .

B. Primary, Thermostatic, Water Mixing Valves :
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Leonard Valve Company.
    b. Powers; a division of Watts Water Technologies, Inc.
    c. Symmons Industries, Inc.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Cabinet-type, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.

6. Connections: Threaded union inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: .
9. Tempered-Water Design Flow Rate: .
10. Selected Valve Flow Rate at 45-psig Pressure Drop: .
11. Pressure Drop at Design Flow Rate: .
12. Valve Finish: Polished, chrome plated .
13. Piping Finish: Copper.
14. Cabinet: Factory fabricated, stainless steel, for recessed mounting and with hinged, stainless-steel door.

C. Individual-Fixture, Water Tempering Valves :

a. Leonard Valve Company.
b. Powers; a division of Watts Water Technologies, Inc.
c. Symmons Industries, Inc.

2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Setting: 110°F.
9. Tempered-Water Design Flow Rate.

2. 7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers :

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:

a. Strainers NPS 2 and Smaller: 0.020 inch .
b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch .
c. Strainers NPS 5 and Larger: 0.10 inch .

6. Drain: Factory-installed, hose-end drain valve.

2.8 HOSE BIBBS

A. Hose Bibbs :

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.

3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B 1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze .
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Wheel handle.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2. 9 WALL HYDRANTS

A. Nonfreeze Wall Hydrants :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Josam Company.
   b. Woodford Manufacturing Company; a division of WCM Industries, Inc..
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
2. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): Two with each wall hydrant.

B. Vacuum Breaker Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Smith, Jay. R. Mfg. Co.; Division of Smith Industries, Inc.

b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

c. Woodford Manufacturing Company; a division of WCM Industries, Inc.

2. Standard: ASSE 1019, Type A or Type B.

3. Type: Freeze-resistant, automatic draining with integral air-inlet valve.

4. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.

5. Pressure Rating: 125 psig.

6. Operation: wheel handle.

7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.

8. Inlet: NPS 1/2 or NPS 3/4.

9. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.10 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves :

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves :

1. Standard: MSS SP-80 for gate valves.

2. Pressure Rating: Class 125.

3. Size: NPS 3/4.

4. Body: ASTM B 62 bronze.

5. Inlet: NPS 3/4 threaded or solder joint.

6. Outlet: Garden-hose thread complying with ASME B 1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves :

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.

2. Pressure Rating: 200-psig minimum CWP or Class 125.

3. Size: NPS 3/4.

4. Body: Copper alloy or ASTM B 62 bronze.

5. Drain: NPS 1/8 side outlet with cap.

2.11 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. AMTROL, Inc.
   b. Precision Plumbing Products, Inc.
   c. Sioux Chief Manufacturing Company, Inc.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.12 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig (860-kPa) minimum pressure rating at 140 deg F (60 deg C).
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 (DN 10) minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig (1035-kPa) minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 (DN 10) minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.13 TRAP-SEAL DEVICE

A. Trap-Seal Device:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. SureSeal
   b. Precision Plumbing Products, Inc.
   c. Sioux Chief Manufacturing Company, Inc.

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig (860 kPa) minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.

7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.14 SPECIALTY VALVES

A. Comply with requirements for general-duty metal valves in Section 220523 "General-Duty Valves for Plumbing Piping."

2.15 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Flex-Hose Co., Inc.
2. Metraflex, Inc.
3. Hyspan Precision Products, Inc..

B Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 250 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 250 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

C. Install balancing valves in locations where they can easily be adjusted.

D. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install cabinet-type units recessed in or surface mounted on wall as specified.

E. Install Y-pattern strainers for water on supply side of each control valve water pressure- reducing valve solenoid valve .

F. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire- retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."

G. Set nonfreeze, nondraining-type post hydrants in concrete or pavement.

H. Install water-hammer arresters in water piping according to PDI-WH 201.

I. Install air vents at high points of water piping.

J. Install, trap-seal device connect to floor-drain body, trap, or inlet fitting. Adjust device for proper flow.

3.2 CONNECTIONS

A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

3. 3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principle backflow preventers.
4. Double-check, backflow-prevention assemblies.
5. Reduced-pressure-detector, fire-protection, backflow-preventer assemblies.
6. Double-check, detector-assembly backflow preventers.
7. Water pressure-reducing valves.
8. Calibrated balancing valves.
9. Primary, thermostatic, water mixing valves.
10. Primary water tempering valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test each pressure vacuum breaker reduced-pressure-principle backflow preventer double-check, backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

B. Related Sections:

1. Section 221313 "Facility Sanitary Sewers" for sanitary sewerage piping and structures outside the building.
2. Section 221329 "Sanitary Sewerage Pumps" for effluent and sewage pumps.

C. RELATED SECTIONS

D. A. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d) (13):

1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water .
2. Waste, Force-Main Piping: 50 psig .

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 .

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers,

documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

PART 2 – PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Fernco Inc.

b. MIFAB, Inc.

c. Tyler Pipe.

2. Standards: ASTM C 1277 and CISPI 310.

3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

1 Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Fernco, Inc
b. MIFAB, Inc.
c. Tyler Pipe.

2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Cast-Iron, Hubless-Piping Couplings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. MG Piping Products Company.
b. Charlotte Pipe Co.
c. Tyler Pipe Co.
2. Standard: ASTM C 1277.
3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:
a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Dallas Specialty & Mfg. Co.
2. Fernco Inc.
3. Mission Rubber Company; a division of MCP Industries, Inc.
b. Standard: ASTM C 1173.
c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
d. Sleeve Materials:
1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1) Fernco, Inc.
2) Mission Rubber Company; a division of MCP Industries, Inc.

3) Anco - Husky

b. Standard: ASTM C 1460.

c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

5 Pressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) The Ford Meter Box Company, Inc.
2) Dresser, Inc.
3) EBAA Iron, Inc.

b. Standard: AWWA C219.

c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

d. Center-Sleeve Material: Manufacturer's standard.

e. Gasket Material: Natural or synthetic rubber.

f. Metal Component Finish: Corrosion-resistant coating or material.

C. Dielectric Fittings:

1. General Requirements: Assembly of ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

2. Dielectric Unions:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Watts Regulator Co.; a division of Watts Water Technologies, Inc
2) Wilkins; a Zurn company.
3) Jomar International Ltd.

b Description:

1) Standard: ASSE 1079.

2) Pressure Rating: 125 psig minimum at 180 deg F.

3. Dielectric Flanges:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Matco-Norca, Inc.

2) Watts Regulator Co.; a division of Watts Water Technologies, Inc.

3) Wilkins; a Zurn company.

b. Description:

1) Standard: ASSE 1079.

2) Factory-fabricated, bolted, companion-flange assembly.

3) Pressure Rating: 125 psig minimum at 180 deg F.

4. Dielectric-Flange Insulating Kits:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Advance Products & Systems, Inc.

2) Central Plastics Company.

3) Pipeline Seal and Insulator, Inc.

a. Description:

1) Nonconducting materials for field assembly of companion flanges.

2) Pressure Rating: 150 psig .

3) Gasket: Neoprene or phenolic.

4) Bolt Sleeves: Phenolic or polyethylene.

5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Grinnell Mechanical Products.

2) Precision Plumbing Products, Inc.

3) Victaulic Company.

b. Description:

1) Standard: IAPMO PS 66

2) Electroplated steel nipple.

3) Pressure Rating: 300 psig at 225 deg F .

4) End Connections: Male threaded or grooved.

5) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 300000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 2 percent Insert slope downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

P. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

Q. Install force mains at elevations indicated.

R. Plumbing Specialties:

1. Install backwater valves in sanitary waster gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."

2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."

S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

C. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:
   a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
   b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

3. Dielectric Fittings for NPS 2-1/2 to NPS 4 : Use dielectric flange kits .
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Section 220523 "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves:
1. Install shutoff valve on each sewage pump discharge.
2. Install gate or full-port ball valve for piping NPS 2 and smaller.
3. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.
1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Install backwater valves in accessible locations.
3. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6 and NPS 8: 12 feet with 3/4-inch rod.
8. NPS 10 and NPS 12: 12 feet with 7/8-inch rod.

I. Install supports for vertical steel piping every 15 feet.

J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:
1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves with cleanout cover flush with floor in pit with pit cover flush with floor .
6. Comply with requirements for backwater valves cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."

7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main.
2. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.

C. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings ; CISPI hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

E. Aboveground, vent piping NPS 5 and larger shall be[**any of]** the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Galvanized-steel pipe, drainage fittings, and threaded joints.
4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty cast-iron hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

G. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI heavy-duty cast-iron hubless-piping couplings; coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

H. Underground sanitary-sewage force mains NPS 4 and smaller shall be any of the following:
1. Ductile-iron, mechanical-j oint piping and mechanical j oints.
2. Ductile-iron, push-on-j oint piping and push-on j oints.
3. Ductile-iron, grooved-joint piping and grooved joints.
4. Fitting-type transition coupling for piping smaller than NPS 1-1/2 and pressure transition coupling for NPS 1-1/2 and larger if dissimilar pipe materials.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Trench drains.
5. Air-admittance valves.
6. Roof flashing assemblies.
7. Through-penetration firestop assemblies.
8. Miscellaneous sanitary drainage piping specialties
9. Flashing materials.
10. Oil interceptors.
11. Solids interceptors.
12. Trap Seal

B. Related Requirements:

1. Section 221423 "Storm Drainage Piping Specialties" for storm drainage piping inside the building, drainage piping specialties, and drains.
2. Section 334100 "Storm Utility Drainage Piping" for storm draining piping and piping specialties outside the building.
3. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d)(13):
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

J. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

a. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS.

b. Product Data: For each type of product.

c. Include construction details, material descriptions, dimension of individual components and profiles, and finishes.

1.5 INFORMATIONAL SUBMITTALS

A Manufacturer Seismic Qualification Certification: Submit certification that oil interceptors, accessories, and components will withstand seismic forces defined in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. For Sanitary Piping Specialties for Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.9 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."

B. Coordinate size and location of roof penetrations.

PART 2 – PRODUCTS

2. 1 BACKWATER VALVES

A. Horizontal, Cast-Iron Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.

2. Standard: ASME A112.14.1.
3. Size: Same as connected piping.
4. Body: Cast iron.
5. Cover: Cast iron with bolted or threaded access check valve.
6. End Connections: Hubless.
7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field- installed cleanout at floor; replaces backwater valve cover.

B. Drain-Outlet Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Josam Company; Josam Div.
   b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
   c. Watts Drainage Products Inc.

2. Size: Same as floor drain outlet.
3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
4. Check Valve: Removable ball float.
5. Inlet: Threaded.
6. Outlet: Threaded or spigot.

2.2 CLEANOUTS

A. Exposed Metal Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) Josam Company.
      2) MIFAB, Inc.
      3) Smith, Jay R. Mfg. Co.

2. ASME A112.3.1, Stainless-Steel Cleanouts:

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

      1) Josam Company.

2) MIFAB, Inc

3) Smith, Jay R. Mfg. Co

3. Standard: ASME A112.3.1 for stainless steel for cleanout test tee.

4. Size: Same as connected drainage piping

5. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.

6. Closure: Countersunk, brass plug.

7. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

8. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Josam Company.
2) Smith, Jay R. Mfg. Co.
3) Sioux Chief Manufacturing Co., Inc

2. ASME A112.36.2M, Stainless-Steel Cleanouts:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Josam Company.

2) Kusel Equipment Co.

3) Smith, Jay R. Mfg. Co.

3. ASME A112.3.1, Stainless-Steel Cleanouts:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Josam Company.

2) Kusel Equipment Co.

3) Smith, Jay R. Mfg. Co.

4. Standard: ASME A112.36.2M for adjustable housing heavy-duty, adjustable housing threaded, adjustable housing cleanout.

5. Size: Same as connected branch.

6. Type: Adjustable housing Threaded, adjustable housing.

7. Body or Ferrule: Cast iron.

8. Clamping Device: Required.

9. Outlet Connection: Threaded.

10. Closure: Brass plug with straight threads and gasket.

11. Adjustable Housing Material: Cast iron with threads.

12. Frame and Cover Material and Finish: Stainless steel.

13. Frame and Cover Shape: Round.

14. Top Loading Classification: Extra Heavy Duty.

15. Riser: ASTM A 74, Extra-Heavy class, cast-iron drainage pipe fitting and riser to clean out.
16. Standard: ASME A112.3.1.
17. Size: Same as connected branch.
18. Housing: Stainless steel.
19. Closure: Stainless steel with seal.
20. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, stainless wall-installation frame and cover.

2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Smith, Jay R. Mfg. Co
   b. Zurn Plumbing Products Group;
   c. MIFAB, Inc.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: Bottom.
9. Backwater Valve: Not required.
10. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
11. Sediment Bucket: removable.
12. Top or Strainer Material: Stainless steel.
13. Top of Body and Strainer Finish: Nickel bronze.
14. Top Shape: Round.
15. Dimensions of Top or Strainer: 12" grate.
16. Top Loading Classification: Extra Heavy-Duty.

17. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
18. Trap Material: Cast iron.
19. Trap Pattern: Deep-seal P-trap.
20. Trap Features: Cleanout and trap-seal primer valve drain connection.

2.4 TRENCH DRAINS

A. Trench Drains:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
2. Standard: ASME A112.6.3 for trench drains.
3. Material: Polymer, pre-sloped.
4. Flange: Anchor.
5. Clamping Device: Not required.
6. Outlet: Bottom.
7. Grate Material: Ductile iron.
8. Grate Finish: Not required.
9. Dimensions of Frame and Grate: 12inches wide.
10. Top Loading Classification: Extra Heavy-Duty.
11. Trap Material: Stainless steel.
12. Trap Pattern: Special custom catch basin.

B. Special Custom Catch Basins:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. MIFAB, Inc.
   b. Kusel Equipment co..
   c. Wade.
2. Standard: ASME A112.6.3 for trench drains.
3. Grate Material: Ductile iron.
4. Frame Construction: Type 304 stainless steel.
5. Body Material: Type 304 stainless steel.
6. Trap Pattern: Per MIFAB Model T1400-CB1224.
7. Dimensions of Frame and Grate: 12inches wide.
8. Custom 29” depth.
9. Custom 4” no-hub trap side outlet at c/l depth of 21” from top of grate, 8” from bottom of basin.
10. Type 304 stainless steel sediment bucket with handle.

2.5 AIRADMITTANCE VALVES

A. Fixture Air-Admittance Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. RectorSeal.
   b. Studor, Inc.
   c. Oatey.
2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected fixture or branch vent piping.

2.6 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies :
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Acorn Engineering Company; Elmdor/Stoneman Div.
   b. Thaler Metal Industries Ltd.
   c. Mayco Industries, Inc. ~
2. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch- thick, lead flashing collar and skirt extending at least 8 inches (200 mm) from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
   a. Open-Top Vent Cap: Without cap.

1.7 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies :
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. ProSet Systems Inc.
2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

1.8 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains :
1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.

2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps :

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
   a. NPS 2: 4-inch- minimum water seal.
   b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

C. Air-Gap Fittings :

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device :

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings :

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Frost-Resistant Vent Terminals :

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead- coated copper, or galvanized steel.
2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

G. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.9 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.

3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft..
2. Vent Pipe Flashing: 8 oz./sq. ft..

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04- inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill- phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
   a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
   b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
   c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1- inch total depression.
3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining

flooring. Maintain integrity of waterproof membranes where penetrated.

4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

G. Install fixture air-admittance valves on fixture drain piping.

H. Install stack air-admittance valves at top of stack vent and vent stack piping.

I. Install air-admittance-valve wall boxes recessed in wall.

J. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

K. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

L. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

M. Assemble open drain fittings and install with top of hub 2 inches above floor.

N. Install trap seal devices on floor drains and other waste outlets.

O. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

P. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

Q. Install vent caps on each vent pipe passing through roof.

R. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

S. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

T. Install oil interceptors, including trapping, and venting, , according to authorities having jurisdiction and with clear space for servicing.

U. Install wood-blocking reinforcement for wall-mounting-type specialties.

V. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Oil Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.

2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Oil interceptors.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3. 5 FIELD QUALITY CONTROL

3.6 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221323 - SANITARY WASTE INTERCEPTORS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Oil interceptors.

B. RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d) (13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

B. PP: Polypropylene plastic.

1.4 ACTION SUBMITTALS: Notice to Contractors

A. Product Data: For each type of interceptor indicated. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.

B. Shop Drawings: For each type and size of precast-concrete interceptor indicated.

1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, based on input from Installers of the items involved:

1. Interceptors.
2. Piping connections. Include size, location, and elevation of each.
3. Interface with underground structures and utility services.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sanitary waste interceptors to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For sanitary waste interceptors specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

C. Training: For sanitary waste interceptors specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

PART 2 – PRODUCTS

2.1 OIL INTERCEPTORS

A. Oil Interceptors: Precast concrete comply with ASTM C 913.

1. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
2. Structural Design Loads:
   a. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
3. Resilient Pipe Connectors: ASTM C 923, cast or fitted into interceptor walls, for each pipe connection.
4. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP , wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 60 inches.
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
6. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch- minimum width flange and 26-inch- diameter cover.
   a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
   b. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
   c. Include indented top design with lettering cast into cover, using wording equivalent to "OIL INTERCEPTOR."

B. Capacities and Characteristics:

1. Capacity: Clean Separated Oily/Waste, 360 Gallons.
2. Overall Inside Dimensions: 4'-0"W x 12'-0"L x 5'-0" H.
3. Inlet Pipe Size: 6".
   a. Centerline of Inlet to Floor: As shown on the drawings.
   b. Centerline of Outlet to Floor: As shown on the drawings.
4. Waste-Oil-Pumped Outlet Pipe Size: 2".
   a. Centerline of Outlet to Floor: TBD.
5. Trapped Outlet Required: Integral.
6. Vent Pipe Size: 2".
7. Installation Position: Underground with two 4'-0" dia. manhole risers to grade.
8. Duplex submersible sump pumps, as scheduled on the drawings.

9. Coalescing Media 4'- 0" W x 3'-0"H x 4'-0"D.

2.2 PRECAST-CONCRETE MANHOLE RISERS

A. Precast-Concrete Manhole Risers: ASTM C 478, ASTM C 913, with rubber-gasket joints.

1. Structural Design Loads:

a. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).

2. Length: From top of underground concrete structure to grade.

3. Riser Sections: 3-inch minimum thickness and 48-inch diameter.

4. Top Section: Eccentric cone, unless otherwise indicated. Include top of cone to match grade ring size.

5. Gaskets: ASTM C 443, rubber.

6. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP , wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals.

B. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, diameter matching manhole frame and cover, and height as required to adjust the manhole frame and cover to indicated elevation and slope.

C. Manhole Frames and Covers: Ferrous; 44-inch ID by 7- to 9-inch riser with 4-inch- minimum width flange and 48-inch- diameter cover.

1. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.

2. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.

3. Include indented top design with lettering cast into cover, using wording equivalent to the following:

a. Oil Interceptors in Sanitary Sewerage System: "OIL INTERCEPTOR."

PART 3 – EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 INSTALLATION

A. Install precast-concrete interceptors according to ASTM C 891. Set level and plumb.

B. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.

C. Set tops of manhole frames and covers flush with finished surface in pavements. Set tops 3 inches above finish surface elsewhere, unless otherwise indicated.

D. Set tops of grating frames and grates flush with finished surface.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Make piping connections between interceptors and piping systems.

3.4 IDENTIFICATION

A. Identification materials and installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.

1. Use warning tapes or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.5 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for four hours to instruct personnel responsible in operation and maintenance of units.

B. Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00 – COMMISSIONING OF HVAC SYSTEMS.

END OF SECTION 221323

SECTION 221343 - FACILITY PACKAGED OILY WASTE PUMPING STATIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes wet-well, packaged pumping stations with submersible oily waste pumps.

B. RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d) (13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 PERFORMANCE REQUIREMENTS

A. Pressure Rating of Oily waste Pumps and Discharge Piping Components: At least equal to oily waste pump discharge pressure, but not less than 125 psig.

B. Pressure Rating of Other Piping Components: At least equal to system operating pressure.

1.4 ACTION SUBMITTALS Notice to Contractors

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Show fabrication and installation details for each packaged oily waste pumping station. Detail equipment assemblies and indicate dimensions; shipping, installed, and operating weights; loads; required clearances; method of field assembly; components; electrical characteristics; and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of oily waste pump, signed by product manufacturer.

B. Manufacturer Seismic Qualification Certification: Submit certification that packaged oily waste pumping station, accessories, and components will withstand seismic forces defined in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
   b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Qualification Data: For Installer.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For facility packaged oily waste pumping stations to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Training: For facility packaged oily waste pumping stations in Form 816 Article 1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

C. Warranty: For facility packaged oily waste pumping stations in Form 816 Article 1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with HI 1.1-1.2, "Centrifugal Pumps for Nomenclature and Definitions"; HI 1.3, "Centrifugal Pumps for Design and Application"; and HI 1.4, "Centrifugal Pumps for Installation, Operation and Maintenance," for oily waste pumps.

E. Comply with UL 778, "Motor-Operated Water Pumps," for oily waste pumps.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."

1.9 WARRANTY Notice to Contractors

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged oily waste pumping stations that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including shell.

b. Faulty operation of oily waste pumps, controls, or accessories.

c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period for Shells: 5 years from date of Substantial Completion.

3. Warranty Period for Oily waste Pumps and Controls: 5 years from date of Substantial Completion.

4. Warranty Period for Accessories: 5 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 WET-WELL, PACKAGED OILY WASTE PUMPING STATIONS

A. Wet-Well, Packaged Oily waste Pumping Stations with Submersible Oily waste Pumps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Gorman-Rupp Company (The).

b. PumpTech, Inc.

c. Yeomans Chicago Corporation.

2. Description: Factory fabricated, assembled, and tested with wet well for oily waste pumps and collection of sanitary oily waste.

a. Orientation: Shell underground with dry equipment chamber underground with top flush with grade.

b. Shell: Factory fabricated from fiberglass.

c. Entrance Tube: From dry compartment to entrance at grade, and of size required to replace largest piece of equipment, but not smaller than 36 inches (914 mm) in diameter.

d. Oily waste Pumps: Two submersible-type oily waste pumps, with guide rail, quick-disconnect system, controls, and piping. Include ASTM A 48/A 48M, Class 25, nonclog, cast-iron impeller capable of passing solids of 3-inch (76-mm) minimum diameter; and hermetically sealed motor with moisture-sensing probe, mechanical seals, and waterproof power cable.

3. Capacities and Characteristics:

a. Diameter or Dimensions of Shell: TBD

b. Height of Shell Base Section: TBD

c. Pumping Station, Inlet Pipe Size: 4"

d. Pumping Station, Discharge Pipe Size: 1-1/4 inches.

e. Comminutor:

1) Required: 2.

2) Capacity: 15 GPM

3) Pipe Size: 1-1/4

4) Motor Size: 1/2 hp.

5) Electrical Characteristics:

a) Volts: 480V.

b) Phases: 3.

c) Hertz: 60.

f. Pumping Station Electrical Characteristics:

1) Explosion Proof, Class 1, Div 1.

2.2 CONTROLS

A. Float-Switch System: Senses variations of oily waste level in wet well. Include high and low adjustments capable of operating on 6-inch minimum differential of liquid level.

B. Motor Controllers: Magnetic, full voltage, nonreversing. Include undervoltage release, thermal- overload heaters in each phase, manual reset buttons, and hand-automatic selector switches. Include circuit breakers to provide branch-circuit protection for each controller.

C. 120-V accessory controls with 15-A, single-phase circuit breakers or fuses for each item.

D. Control Panel: Enclosure complying with UL 508A and with UL 508A, Supplement SB with separate compartments and covers for controllers, circuit breakers, transformers, alternators, and single-phase controls. Include 20-A duplex receptacle in NEMA WD 1, Configuration 5-20R mounted on exterior of control panel.

1. Mounting: On wall in maintenance area.
2. Enclosure: NEMA 250, Type 4.

E. Install labels on panel face to identify switches and controls.

F. Wiring: Tin-copper wiring.

2.3 ACCESSORIES

A. Lighting: Minimum of 2, UL 1571, heavy-duty, cast-metal, wet-location-type fixtures with 100- W bulbs and guards in service area. Locate switches, with pilot lights, at chamber entrance.

B. Submersible Sump Pump:

1. Discharge Size: NPS 1-1/4 minimum.
2. Pump End Bell and Motor Shell: Cast iron.
3. Motor: 1/2 hp, 1750-rpm, hermetically sealed, capacitor-start, with built-in overload protection.
4. Impeller: ASTM B 584, cast bronze or ASTM B 36/B 36M, brass.
5. Shaft: Stainless steel.
6. Bearings: Grease-lubricated, factory-sealed ball bearings.
7. Seals: Mechanical.
8. Accessories: Inlet strainer.
9. Controls: Float switch.

C. High-Water Audio Alarm: Horn for audio indication of station high-water level, energized by separate level-detecting device. Include alarm silencer switch and relay in station.

D. Remote Alarm Circuit: Include contacts for connection to remote alarm panel.

2.4 MOTORS

A. General requirements for motors are specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect oily waste pumps according to HI 1.6, "Centrifugal Pump Tests." Include test recordings that substantiate correct performance of pumps at design head, capacity, suction lift, speed, and horsepower.

B. Test accessories and controls through complete cycle. Include test recordings that substantiate correct performance.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of sewerage piping systems to verify actual locations of piping connections before packaged oily waste pumping station installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 300000 "Earth Moving."

3.3 INSTALLATION

A. Install packaged oily waste pumping station components where indicated, according to specific equipment and piping arrangement indicated.

B. Shell Base Supports: Form from structural-steel beams, of number and lengths required to support bottom of shell and to anchor beams to concrete foundation.

1. Use elevator blocks attached to bottom of shell to slope station floor 1 inch in 10 feet down toward sump.

C. Grout under and around shell. Ensure that there are no voids between foundation slab and underslab of pumping station.

D. Fill voids between shell sidewalls, sleeves, and piping and make watertight seal with grout.

E. Connect anode conductors to grounding lugs on steel housing.

F. Join separate sections of housing by field welding.

G. Field weld entrance tube to housing.

3.4 CONNECTIONS

A. Sanitary sewer piping installation requirements are specified in Section 221313 "Facility Sanitary Sewers." Drawings indicate general arrangement of piping.

B. Install piping adjacent to machine to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 IDENTIFICATION

A. Install identifying labels permanently attached to equipment.

B. Install operating instruction signs permanently attached to equipment or on pumping station wall near equipment.

3.6 PAINTING

A. Prepare and paint ferrous piping in wet wells, structural-steel supports, and anchor devices with coal-tar epoxy-polyamide paint according to SSPC-Paint 16.

B. Paint field-welded areas to match factory coating.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform field tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.. Report results in writing.

C. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing packaged sewage pumping stations and after electrical circuitry has been energized, test for compliance with requirements. Furnish water required for pump tests.
2. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Remove and replace packaged sewage pumping stations that do not pass tests and inspections and retest as specified above.

3.8 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Adjust pump, accessory, and control settings, and safety and alarm devices.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged sewage pumping stations.

END OF SECTION 221343

SECTION 221345 - FACILITY PACKAGED STORM WATER PUMPING STATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes wet-well, packaged pumping stations with submersible storm pumps.

B. RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d)(13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 PERFORMANCE REQUIREMENTS

A. Pressure Rating of Storm Pumps and Discharge Piping Components: At least equal to storm pump discharge pressure, but not less than 125 psig.

B. Pressure Rating of Other Piping Components: At least equal to system operating pressure.

1.4 ACTION SUBMITTALS Notice to Contractors

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Show fabrication and installation details for each packaged storm pumping station. Detail equipment assemblies and indicate dimensions; shipping, installed, and operating weights; loads; required clearances; method of field assembly; components; electrical characteristics; and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of storm pump, signed by product manufacturer.

B. Manufacturer Seismic Qualification Certification: Submit certification that packaged storm pumping station, accessories, and components will withstand seismic forces defined in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Qualification Data: For Installer.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For facility package storm water pumping stations to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Training: For facility package storm water pumping stations specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

C. Warranty: For facility package storm water pumping stations specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with HI 1.1-1.2, "Centrifugal Pumps for Nomenclature and Definitions"; HI 1.3, "Centrifugal Pumps for Design and Application"; and HI 1.4, "Centrifugal Pumps for Installation, Operation and Maintenance," for storm pumps.

E. Comply with UL 778, "Motor-Operated Water Pumps," for storm pumps.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged storm pumping stations that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including shell.

b. Faulty operation of storm pumps, controls, or accessories.

c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period for Shells: 5 years from date of Substantial Completion.

3. Warranty Period for Storm Pumps and Controls: 5 years from date of Substantial Completion.

4. Warranty Period for Accessories: 5 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 WET-WELL, PACKAGED STORM PUMPING STATIONS

A. Wet-Well, Packaged Storm Pumping Stations with Submersible Storm Pumps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Gorman-Rupp Company (The).

b. Metropolitan Industries, Inc.

c. PumpTech, Inc.

2. Description: Factory fabricated, assembled, above grade fiberglass valve and control chamber, and tested with wet well for storm water pumps and collection of storm water and footing drains and with above grade dry equipment enclosure for controls and accessories.

a. Orientation: Shell underground with dry equipment chamber above ground in factory fabricated fiberglass enclosure.

b. Shell: Factory fabricated concrete.

c. Entrance Tube: From dry compartment to entrance at grade, and of size required to replace largest piece of equipment, but not smaller than 36 inches (914 mm) in diameter.

d. Storm Pumps: Two submersible-type storm pumps, with guide rail, quick- disconnect system, controls, and piping. Include ASTM A 48/A 48M, Class 25, nonclog, cast-iron impeller capable of passing solids of 3-inch (76-mm) minimum diameter; and hermetically sealed motor with moisture-sensing probe, mechanical seals, and waterproof power cable.

3. Capacities and Characteristics:

a. Diameter or Dimensions of Shell: TBD

b. Height of Shell Base Section: TBD

c. Pumping Station, Inlet Pipe Size: 8"

d. Pumping Station, Discharge Pipe Size: 4"

e. Comminutor:

1) Required: No.

2) Capacity: As scheduled

3) Pipe Size: As schedule

4) Motor Size: As scheduled.

5) Electrical Characteristics:

a) Volts: 480 V.

b) Phases: Three.

c) Hertz: 60.

f. Pumping Station Electrical Characteristics:

1) Full-Load Amperes: TBD

2) Minimum Circuit Ampacity: TBD

3) Maximum Overcurrent Protection: TBD

2.2 CONTROLS

A. Control Sequence of Operation: Cycle each storm water pump on and off automatically to maintain wet-well water level. Automatic control operates both pumps in parallel if wet-well level rises above starting point of low-level pump, until shutoff level is reached. Automatic alternator, with manual disconnect switch, changes sequence of lead-lag storm pumps at completion of each pumping cycle.

B. Float-Switch System: Senses variations of storm level in wet well. Include high and low adjustments capable of operating on 6-inch minimum differential of liquid level.

C. Motor Controllers: Magnetic, full voltage, nonreversing. Include undervoltage release, thermal- overload heaters in each phase, manual reset buttons, and hand-automatic selector switches. Include circuit breakers to provide branch-circuit protection for each controller.

D. 120-V accessory controls with 15-A, single-phase circuit breakers or fuses for each item.

E. Control Panel: Enclosure complying with UL 508A and with UL 508A, Supplement SB with separate compartments and covers for controllers, circuit breakers, transformers, alternators, and single-phase controls. Include 20-A duplex receptacle in NEMA WD 1, Configuration 5-20R mounted on exterior of control panel.

1. Mounting: In grade level pump enclosure.

2. Enclosure: NEMA 250, Type 4.

F. Install labels on panel face to identify switches and controls.

G. Wiring: Tin-copper wiring.

2.3 ACCESSORIES

A. Lighting: Minimum of 2, UL 1571, heavy-duty, cast-metal, wet-location-type fixtures with 100- W bulbs and guards in service area. Locate switches, with pilot lights, at chamber entrance.

B. Submersible Sump Pump:

1. Discharge Size: NPS 3 minimum.

2. Pump End Bell and Motor Shell: Cast iron.

3. Motor: hermetically sealed, capacitor-start, with built-in overload protection.

4. Impeller: ASTM B 584, cast bronze or ASTM B 36/B 36M, brass.

5. Shaft: Stainless steel.
6. Bearings: Grease-lubricated, factory-sealed ball bearings.
7. Seals: Mechanical.
8. Accessories: Inlet strainer.
9. Controls: Float switch.

C. High-Water Audio Alarm: Horn for audio indication of station high-water level, energized by separate level-detecting device. Include alarm silencer switch and relay in station.

D. Remote Alarm Circuit: Include contacts for connection to remote alarm panel.

2.4 MOTORS

A. General requirements for motors are specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

2.5 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 6/A 6M, W or HP shapes, or ASTM A 36/A 36M, plates or beams.

B. Grout: ASTM C 1107, Grade B, nonshrink cement grout.

1. Design Mix: 5000-psi, 28-day compressive strength.

C. Concrete: Concrete is specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."

2.6 SOURCE QUALITY CONTROL

A. Test and inspect storm pumps according to HI 1.6, "Centrifugal Pump Tests." Include test recordings that substantiate correct performance of pumps at design head, capacity, suction lift, speed, and horsepower.

B. Test accessories and controls through complete cycle. Include test recordings that substantiate correct performance.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of sewerage piping systems to verify actual locations of piping connections before packaged storm pumping station installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 300000 "Earth Moving."

3.3 INSTALLATION

A. Install packaged storm pumping station components where indicated, according to specific equipment and piping arrangement indicated.

B. Shell Base Supports: Form from structural-steel beams, of number and lengths required to support bottom of shell and to anchor beams to concrete foundation.

1. Use elevator blocks attached to bottom of shell to slope station floor 1 inch in 10 feet down toward sump.

C. Grout under and around shell. Ensure that there are no voids between foundation slab and underslab of pumping station.

D. Fill voids between shell sidewalls, sleeves, and piping and make watertight seal with grout.

E. Connect anode conductors to grounding lugs on steel housing.

F. Join separate sections of housing by field welding.

3.4 CONNECTIONS

A. Storm water piping installation requirements are specified in Section 221413 "Facility Storm drainage." Drawings indicate general arrangement of piping.

B. Install piping adjacent to machine to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 IDENTIFICATION

A. Install identifying labels permanently attached to equipment.

B. Install operating instruction signs permanently attached to equipment or on pumping station wall near equipment.

C. Arrange for installing green warning tape or detectable warning tape over outside edges of underground packaged storm pumping stations. Tape materials and their installation are specified in Section 300000 "Earth Moving."

3.6 PAINTING

A. Prepare and paint ferrous piping in wet wells, structural-steel supports, and anchor devices with coal-tar epoxy-polyamide paint according to SSPC-Paint 16.

B. Paint field-welded areas to match factory coating.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform field tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.. Report results in writing.

C. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing packaged storm water pumping stations and after electrical circuitry has been energized, test for compliance with requirements. Furnish water required for pump tests.
2. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Remove and replace packaged storm pumping stations that do not pass tests and inspections and retest as specified above.

3.8 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Adjust pump, accessory, and control settings, and safety and alarm devices.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged storm pumping stations.

END OF SECTION 221343

SECTION 221413 - FACILITY STORM DRAINAGE PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

B. Related Sections:

1. Section 221429 "Sump Pumps" for storm drainage pumps.
2. Section 334100 "Storm Utility Drainage Piping" for storm drainage piping outside the building.
3. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d)(13):
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.
2. Storm Drainage, Force-Main Piping: 50 psig.

B. Seismic Performance: Storm drainage piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For storm drainage piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 – PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. MIFAB, Inc
b. Mission Rubber Company; a division of MCP Industries, Inc
c. Fernco Inc.

2. Standards: ASTM C 1277 and CISPI 310.

3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Fernco

b. MIFAB, Inc.

c. Mission Rubber Company; a division of MCP Industries, Inc.

2. Standards: ASTM C 1277 and ASTM C 1540.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Cast-Iron, Hubless-Piping Couplings:

1. Standard: ASTM C 1277.

2. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.

2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping- system fitting.
3. Unshielded, Non-pressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1) Dallas Specialty & Mfg. Co.
      2) Fernco Inc.
      3) Mission Rubber Company; a division of MCP Industries, Inc.
   b. Standard: ASTM C 1173.
   c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
   d. Sleeve Materials:
      1. For Dissimilar Pipes: ASTM D 5926, or other material compatible with pipe materials being joined.
4. Shielded, Non-pressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1. Cascade Waterworks Mfg. Co.
      2 Mission Rubber Company; a division of MCP Industries, Inc.
      3. Dresser Industries
   b. Standard: ASTM C 1460.
   c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
5. Pressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      1. Cascade Waterworks Mfg. Co.
      2 Mission Rubber Company; a division of MCP Industries, Inc.
      3. Dresser Industries
   b. Standard: AWWA C219.
   c. Description: Metal, sleeve-type couplings same size as, with pressure rating at least equal to and ends compatible with, pipes to be joined.
   d. Center-Sleeve Material: Manufacturer's standard.
   e. Gasket Material: Natural or synthetic rubber.
   f. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:
   1. General Requirements: Assembly of ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
   2. Dielectric Unions:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1 Jomar International Ltd.

2. Hart Industries International, Inc.

3. .Matco-Norca, Inc

b. Description:

1 Standard: ASSE 1079.

2 Pressure Rating: 150 psig at 180 deg F.

3. Dielectric Flanges:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Matco-Norca, Inc.

2) Watts Regulator Co.; a division of Watts Water Technologies, Inc.

3) Wilkins; a Zurn company.

b. Watts:

1) Standard: ASSE 1079.

2) Factory-fabricated, bolted, companion-flange assembly.

3) Pressure Rating: 150 psig.

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4. Dielectric-Flange Insulating Kits:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Advance Products & Systems, Inc.

2) Central Plastics Company.

3) Pipeline Seal and Insulator, Inc.

b. Description:

1) Nonconducting materials for field assembly of companion flanges.

2) Pressure Rating: 150 psig.

3) Gasket: Neoprene or phenolic.

4) Bolt Sleeves: Phenolic or polyethylene.

5) Washers: Phenolic with steel-backing washers.

5. Dielectric Nipples:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Victaulic Company.

2) Grinnell Mechanical Products.

3) Precision Plumbing Products, Inc.

b. Description:

1) Electroplated steel nipple complying with ASTM F 1545.

2) Pressure Rating: 300 psig at 225 deg F .

3) End Connections: Male threaded or grooved.

4) Lining: Inert and noncorrosive, propylene.

PART 3 – EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 300000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

L. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

M. Install storm drainage piping at the following minimum slopes unless otherwise indicated:

1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 and larger.

2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

N. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

P. Install force mains at elevations indicated.

Q. Plumbing Specialties:

1. Install backwater valves in storm drainage gravity-flow piping. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."

2. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."

3. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

C. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping

grooves. Install and tighten housing bolts.

F. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force-Main Piping: Fitting-type transition couplings.
4. In Underground Force-Main Piping:
   a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
   b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flange kits
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Section 220523 "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves: Install shutoff valve on each sump pump discharge.

1. Install gate or full-port ball valve for piping NPS 2 and smaller.
2. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing-check valve, between pump and shutoff valve, on each sump pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Install backwater valves in accessible locations.
3. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.

3. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
4. Vertical Piping: MSS Type 8 or Type 42, clamps.
5. Individual, Straight, Horizontal Piping Runs:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
6. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
7. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting valve and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.
1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
2. Comply with requirements for cleanouts and drains specified in Section 221423 "Storm Drainage Piping Specialties."

D. Connect force-main piping to the following:
1. Storm Sewer: To exterior force main.
2. Sump Pumps: To sump pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections according to the following unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after

roughing-in.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.10 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping NPS 6 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, storm drainage piping NPS 8 and larger shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Underground storm drainage piping NPS 6 and smaller shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI, cast-iron, hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

E. Underground, storm drainage piping NPS 8 and larger shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI, cast-iron, hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

F. Underground storm drainage force mains NPS 4 and smaller shall be any of the following:
1. Ductile-iron, push-on-joint piping and push-on joints.
2. Ductile-iron, grooved-joint piping and grooved joints.
3. Fitting-type transition coupling for piping smaller than NPS 1-1/2 and pressure transition coupling for NPS 1-1/2 and larger if dissimilar pipe materials.

G. Underground storm drainage force mains NPS 5 and larger shall be any of the following:
1. Ductile-iron, push-on-j joint piping and push-on joints.
2. Ductile-iron, grooved-joint piping and grooved joints.
3. Pressure transition couplings if dissimilar pipe materials.

END OF SECTION 221413

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof drains.
2. Miscellaneous storm drainage piping specialties
3. Cleanouts.
4. Backwater valves.
5. Through-penetration firestop assemblies.
6. Flashing materials.

B. RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d) (13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1. Include construction details, material descriptions, dimension of individual components and profiles, and finishes.

1. 4. QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 – PRODUCTS

2.1 METAL ROOF DRAINS

A. Dual Outlet Roof Drain/Overflow :

1. Basis-of-Design Product: Subject to compliance with requirements, provide Watts RD- 700 Dual Outlet Roof Drain/Overflow or comparable product by one of the following:

a. Watts
b. Zurn
c. Jozam

2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 6-3/4" x 14-3/4".
5. Combination Flashing Ring and Gravel Stop: Required.
6. Flow-Control Weirs: Not required.
7. Outlet: Bottom.
8. Extension Collars: Required.
9. Underdeck Clamp: Not required.
10. Expansion Joint: Not required.
11. Sump Receiver Plate: Not required.
12. Dome Material: Ductil Iron.
13. Perforated Gravel Guard: Stainless steel.
14. Vandal-Proof Dome: Required.
15. Water Dam: Dual combination drain with 2 inch dam for overflow protection.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Overflow Conductor Nozzles:

1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes, bird screen and hinged perforated outlet. .
2. Size: Same as connected conductor.

2.3 CLEANOUTS

A. Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Josam Company.
   b. Smith, Jay R. Mfg. Co.
   c. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M, for adjustable housing threaded, adjustable housing cleanouts.
3. Size: Same as connected branch.
4. Type: Adjustable housing Threaded, adjustable housing.
5. Body or Ferrule Material: Cast iron.
6. Clamping Device: Not required.
7. Outlet Connection: Threaded.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Stainless steel.
11. Frame and Cover Shape: Round.
12. Top-Loading Classification: Extra-Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to clean-out.

B. Test Tees:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Josam Company.
   b. Zurn Plumbing Products Group; Specification
   c. Smith, Jay R. Mfg. Co.
2. Standard: ASME A112.36.2M and ASTM A 74, cleanout test tees.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe pipe test tee as required to match connected piping.
5. Closure Plug: Countersunk.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Josam Company.
   b. Smith, Jay R. Mfg. Co.
   c. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
3. Size: Same as connected drainage piping.
4. Body Material: Hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, cover plate with screw.
8. Wall Access: Round, stainless steel wall-installation frame and cover.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. ProSet Systems Inc.
   b. Unique Fire Stop Products, Inc.
   c. Hilti
2. Standard: ASTM E 814, for through-penetration firestop assemblies.
3. Certification and Listing: Insert testing agency acceptable to authorities having jurisdiction for through-penetration firestop assemblies.
4. Size: Same as connected pipe.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.

6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
7. Special Coating: Corrosion resistant on interior of fittings.

2.5 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M,12 oz./sq. ft..
B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04- inch minimum thickness unless otherwise indicated. Include G90 hot-dip galvanized, mill- phosphatized finish for painting if indicated.
C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
D. Fasteners: Metal compatible with material and substrate being fastened.
E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
F. Solder: ASTM B 32, lead-free alloy.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
   1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
   2. Install expansion joints, if indicated, in roof drain outlets.
   3. Position roof drains for easy access and maintenance.
B. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
   1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
   3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate cleanouts at base of each vertical soil and waste stack.
C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
E. Install horizontal backwater valves in floor with cover flush with floor.
F. Install drain-outlet backwater valves in outlet of drains.
G. Install test tees in vertical conductors and near floor.
H. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

I. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.

J. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

K. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.

L. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. lead sheets, 0.0938-inch thickness or thicker. Solder joints of 4.0-lb/sq. ft. lead sheets, 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches and with skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 ROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Residential, small-capacity, electric, domestic-water heaters.
2. Flow-control, electric, tankless, domestic-water heaters.
3. Thermostat-control, electric, tankless, domestic-water heaters.
4. Domestic-water heater accessories.

B. RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d)(13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. Include construction details, material descriptions, dimension of individual components and profiles, and finishes.

C. LEED Submittals:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, Section 7, "Service Water Heating."

D. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For commercial domestic-water heaters, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Product Certificates: For each type of commercial and, electric, domestic-water heater, from manufacturer.

C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

D. Source quality-control reports.

E. Field quality-control reports.

F. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For electric, domestic water heaters to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTCIE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For electric, domestic water heaters specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOEOUT DOCUMENTS.

C. Training: For electric, domestic water heaters specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOEOUT DOCUMENTS.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

E. Manufacturers Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.

b. Faulty operation of controls.

c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

a. Electric, Tankless, Domestic-Water Heaters: Five year(s).

b. Compression Tanks: Five years.

PART 2 – PRODUCTS

2.1 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS

A Flow-Control, Electric, Tankless, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Bosch Water Heating.

b. Eemax, Inc.

c. Stiebel Eltron, Inc.

2. Standard: UL 499 for electric, tankless, (domestic-water heater) heating appliance.

3. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.

a. Connections: ASME B1.20.1 pipe thread.

b. Pressure Rating: 150 psig.

c. Heating Element: Resistance heating system.

d. Temperature Control: Flow-control fitting.

e. Safety Control: High-temperature-limit cutoff device or system.

f. Jacket: Aluminum or steel with enameled finish or plastic.

4. Support: Bracket for wall mounting.

5. Capacity and Characteristics:

B. As scheduled on the drawings.

C. Thermostat-Control, Electric, Tankless, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Bosch Water Heating.

b. Chronomite Laboratories, Inc.

c. Eemax, Inc.

2. Standard: UL 499 for electric, tankless, (domestic-water heater) heating appliance.

3. Construction: Copper piping or tubing complying with NSF 61 barrier materials for potable water, without storage capacity.

a. Connections: ASME B1.20.1 pipe thread.

b. Pressure Rating: 150 psig.

c. Heating Element: Resistance heating system.

d. Temperature Control: Thermostat.

e. Safety Control: High-temperature-limit cutoff device or system.

f. Jacket: Aluminum or steel with enameled finish or plastic.

4. Support: Bracket for wall mounting.

5. Capacity and Characteristics:

a. As scheduled on the drawings.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

C. Heat-Trap Fittings: ASHRAE 90.2.

1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

2. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."

D. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig- maximum outlet pressure unless otherwise indicated.

E. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic- water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

F. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic- water heater working-pressure rating.

G. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

H. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

I. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.

J. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test[**commercial]** domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 – EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters at least 18 inches above floor on wall bracket. Heaters for emergency shower/eyewash stations shall be mounted within roof structural steel; control panel shall be mounted at 42" above floor level.

1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

C. Install commercial, electric, domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

D. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

F. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

G. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

H. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

I. Fill electric, domestic-water heaters with water.

J. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain tankless, electric, domestic-water heaters.

END OF SECTION 223300

SECTION 224213.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d)(13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 SUMMARY

A. Section Includes:

1. Water closets.
2. Flushometer valves
3. Macerating toilet system..
4. Toilet seats.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product

1. Include construction details, material descriptions, dimension of individual components and profiles, and finishes.

C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For commercial water closets to include in the operation maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Spare Parts: For commercial water specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Macerating toilet Repair Kits: one of each type.

PART 2 – PRODUCTS

2.1 WALL-MOUNTED WATER CLOSETS

A. Water Closets: Wall mounted, top spud, accessible.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Standard America.
   b. Kohler Co.
   c. Zurn Industries, LLC; Commercial Brass and Fixtures.
2. Bowl:
   a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
   b. Material: Vitreous china.
   c. Type: Siphon jet.
   d. Style: Flushometer valve.
   e. Height: Standard.
   f. Rim Contour: Elongated.
   g. Water Consumption: 1.28 gal. per flush.
   h. Spud Size and Location: NPS 1-1/2; top.
3. Flushometer Valve: As scheduled..
4. Toilet Seat: Heavy duty open front..
5. Support:
   a. Bariatric.
   b. Standard: ASME A112.6.1M.
   c. Description: Waste-fitting assembly as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
   d. Water-Closet Mounting Height: Handicapped/elderly according to ICC/ANSI A117.1.

2.2 FLUSHOMETER VALVES

A. Solenoid-Actuator, Diaphragm Flushometer Valves: As scheduled:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Coyne & Delany Co.
   b. Sloan Valve Company.
   c. Zurn Industries, LLC; Commercial Brass and Fixtures.
2. Standard: ASSE 1037.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.

8. Style: Exposed.
9. Actuator: Solenoid complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
10. Trip Mechanism: Hard wired electronic sensor complying with UL 1951, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
11. Consumption: 1.28 gal. per flush.
12. Minimum Inlet: NPS 1.
13. Minimum Outlet: NPS 1-1/4.

2.3 TOILET SEATS

A. Toilet Seats:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Standard America.
   b. Bemis Manufacturing Company.
   c. Church Seats.
2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining, check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: Black.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.
B. Examine walls and floors for suitable conditions where water closets will be installed.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:
1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:
1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.
5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:
1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:
1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224213.16 - COMMERCIAL URINALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d)(13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 SUMMARY

A. Section Includes:

1. Urinals.
2. Flushometer valves.

B. Related Requirements:

1.4 ACTION SUBMITTALS Notice to Contractors

1.5

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for urinals.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Prerequisite WE 1 and Credit WE 3 , Credit WE 2, and Credit WE 3: Documentation indicating flow and water consumption requirements.
2. Product Data for Prerequisite WE 1: Documentation indicating flow and water consumption requirements.
3. Product Data for Prerequisite WE 1 and Credit WE 2: Documentation indicating flow and water consumption requirements.

C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For commercial urinals to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Spare Parts: For commercial urinals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE

TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

PART 2 - PRODUCTS

2.1 WALL-HUNG URINALS

A. Urinals: Wall hung, back outlet, washout, accessible. As scheduled

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Standard America.
b. Zurn Industries, LLC; Commercial Brass and Fixtures
c. Kohler Co.

2. Fixture:

a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
b. Material: Vitreous china.
c. Type: Washout with extended shields.
d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
e. Water Consumption: Water saving 0.125 gallons per flush.
f. Spud Size and Location: NPS 3/4, top.
g. Outlet Size and Location: NPS 2, back.
h. Color: White.

3. Flushometer Valve: As scheduled.

4. Waste Fitting:

a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
b. Size: NPS 2.

5. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.

2.2 URINAL FLUSHOMETER VALVES

A. Solenoid-Actuator, Diaphragm Flushometer Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Coyne & Delany Co.
b. Sloan Valve Company.
c. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Standard: ASSE 1037.

3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Exposed Flushometer-Valve Finish: Chrome plated.
7. Panel Finish: Chrome plated or stainless steel.
8. Style: Exposed.
9. Actuator: Solenoid complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
10. Trip Mechanism: hard wired electronic sensor complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
11. Consumption: 0.125 gal. per flush.
12. Minimum Inlet: NPS 3/4.
13. Minimum Outlet: NPS 3/4.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.

B. Examine walls and floors for suitable conditions where urinals will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Urinal Installation:
1. Install urinals level and plumb according to roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
3. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.

B. Support Installation:
1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
3. Use carriers without waste fitting for urinals with tubular waste piping.
4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

C. Flushometer-Valve Installation:
1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Wall Flange and Escutcheon Installation:
1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing

Piping."

E. Joint Sealing:

1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew- resistant silicone sealant.
2. Match sealant color to urinal color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed urinals and fittings.

C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.16

SECTION 224216.13 - COMMERCIAL LAVATORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Lavatories.
2. Faucets.

B. RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d) (13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS Notice to Contractors

A. Maintenance Data: For commercial lavatories to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT SUBMITTALS.

1. Servicing and adjustments of automatic faucets.
2. Spare Parts: For commercial lavatories specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 – PRODUCTS

2.1 INTEGRAL COUNTER LAVATORIES

A. Refer to Architectural for size and material.

1. ISSFA-2 and ANSI _ Z124.3 Type 5 or 6.
2. Fixture:
   a. Standard: ASME A112.19.2/CSA B45.1.
   b. Type: Self-rimming for above-counter mounting.
   c. Nominal Size: Oval, 20 by 17 inches.
   d. Faucet-Hole Punching: One hole Three holes, 2-inch centers Three holes, 4-inch centers.
   e. Faucet-Hole Location: Top.
   f. Color: White.
   g. Mounting Material: Sealant.
3. Faucet: Automatically operated.

2.2 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory: Ledge back, vitreous china, wall mounted.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Standard America.
   b. Kohler Co.
   c. Crane Plumbing, L.L.C.

2. Fixture:
   a. Standard: ASME A112.19.2/CSA B45.1.
   b. Type: For wall hanging.
   c. Nominal Size: Oval, 19 by 16 inches.
   d. Faucet-Hole Punching: One hole Three holes, 2-inch centers.
   e. Faucet-Hole Location: Top.
   f. Color: White.
   g. Mounting Material: Chair carrier.
3. Faucet: Automatically Operated.
4. Support: ASME A112.6.1M, Type II, concealed-arm lavatory carrier. Include rectangular, steel uprights.

2.3 SOLID-BRASS, AUTOMATICALLY OPERATED LAVATORY FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components – Health Effects," for

faucet materials that will be in contact with potable water.

B. Lavatory Faucets: Automatic-type, hard wired, electronic-sensor-operated, nonmixing, solid- brass valve.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Standard America.
   b. Kohler Co.
   c. Zurn Industries, LLC, Commercial Brass and Fixtures
2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in
4. NFPA 70, by a qualified testing agency, and marked for intended location and application.
5. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
6. Body Type: Single hole.
7. Body Material: Commercial, solid brass.
8. Finish: Polished chrome plate.
9. Maximum Flow Rate: 0.5 gpm.
10. Mounting Type: Deck, concealed.
11. Spout: Rigid type.
12. Spout Outlet: Aerator.
13. Drain: Not part of faucet.

2.4 SUPPLY FITTINGS

A NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components – Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Hand.

F. Risers:

1. NPS 1/2.
2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

2.4 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

C. Trap:

1. Size: NPS 1-1/2 by NPS 1-1/4.
2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- thick brass

tube to wall; and chrome-plated, brass or steel wall flange.

3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch- thick stainless-steel tube to wall; and stainless-steel wall flange.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew- resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 224216.16 - COMMERCIAL SINKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Service basins.
2. Service sinks.
3. Utility sinks.
4. Handwash sinks.
5. Sacristy sinks.
6. Sink faucets.
7. Laminar-flow, faucet-spout outlets
8. Supply fittings.
9. Waste fittings.

B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for residential sinks.
2. A. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d) (13):
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For commercial sinks to include in the operation maintenance manuals in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Spare Parts: For commercial sinks specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 SERVICE SINKS

A. Service Sinks: Enameled, cast iron, trap standard mounted.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Standard America.
   b. Kohler Co.
   c. Zurn Industries, LLC; Commercial Brass and Fixtures.

2. Fixture:
   a. Standard: ASME A112.19.1/CSA B45.2.
   b. Type: Service sink with back.
   c. Back: Two faucet holes.
   d. Nominal Size: 22 by 18 inches.
   e. Color: White.
   f. Mounting: NPS 3 P-trap standard with grid strainer inlet, cleanout, and floor flange.
   g. Rim Guard: On front and sides.
3. Faucet: HAnd.
4. Support: ASME A112.6.1M, Type II, sink carrier.

2.2 UTILITY SINKS

A. Utility Sinks: Stainless steel, counter mounted.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Advance Tabco.
   b. Elkay Manufacturing Co.
   c. Just Manufacturing.
2. Fixture:
   a. Standard: ASME A112.19.3/CSA B45.4.
   b. Type: Ledge back.

c. Number of Compartments: One.

d. Overall Dimensions: 25" x 22".

e. Metal Thickness: 0.050 inch.

f. Compartment:

1) Dimensions: 23" x 17" .

2) Drain: Grid with NPS 1-1/2 tailpiece and twist drain.

3) Drain Location: Near back of compartment.

3. Faucet(s): ADA, single handle lever.

a. Number Required: One.

b. Mounting: On ledge.

4. Supply Fittings:

a. Standard: ASME A112.18.1/CSA B125.1.

b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.

1) Operation: Loose key.

2) Risers: NPS 1/2, ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

5. Waste Fittings:

a. Standard: ASME A112.18.2/CSA B125.2.

b. Trap(s):

1) Size: NPS 1-1/2.

2) Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated brass or steel wall flange.

6. Mounting: On counter with sealant.

2.3 SINK FAUCETS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components – Health Effects," for faucet-spout materials that will be in contact with potable water.

B. Sink Faucets: Manual type, single-control mixing valve.

1 Commercial, Solid-Brass Faucets.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) American Standard America.
2) Chicago Faucets
3) .Kohler Co.

2. General-Duty, Solid-Brass Faucets.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) American Standard America.
2) Zurn Plumbing Products Group
3) Kohler Co.

3. Standard: ASME A112.18.1/CSA B125.1.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
5. Body Type: Centerset or Widespread.
6. Body Material: General-duty, solid brass.
7. Finish: Chrome plated.
8. Maximum Flow Rate: 2.2 gpm.
9. Handle(s): Lever; ADA.
10. Mounting Type: Deck, exposed.
11. Spout Type: Swing, solid brass.
12. Vacuum Breaker: Required for hose outlet.
13. Spout Outlet: Aerator or Hose thread according to ASME B1.20.

2.4 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components – Health Effects," for supply-fitting materials that will be in contact with potable water.
B. Standard: ASME A112.18.1/CSA B125.1.
C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.
D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
E. Operation: Loose key.
F. Risers:
    1. NPS 1/2
    2. ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

2.5 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.
B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
C. Trap:
    1. Size: NPS 1-1/2.
    2. Material: Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch- thick brass tube to wall; and chrome-plated brass or steel wall flange.
    3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch- thick stainless-steel tube to wall; and stainless-steel wall flange.

2.6 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
B. Characteristics: Nonshrink; recommended for interior and exterior applications.
C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sinks level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-hung sinks.

C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.

D. Set floor-mounted sinks in leveling bed of cement grout.

E. Install water-supply piping with stop on each supply to each sink faucet.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."

2. Install stops in locations where they can be easily reached for operation.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew- resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3. 5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

SECTION 224223 - COMMERCIAL SHOWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Individual shower receptors
2. Shower faucets.
3. Shower basins.
4. Group showers.
5. Outdoor showers.

B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for residential showers.
2. Section 224500 "Emergency Plumbing Fixtures" for emergency showers.
3. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d)(13):
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for showers and basins.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS Notice to Contractors

A. Maintenance Data: For shower faucets to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

PART 2 - PRODUCTS

2.1 INDIVIDUAL SHOWERS

A. Individual PMMA Showers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Acryline USA, Inc.
b. Crane Plumbing, L.L.C
c. Praxis Industries, LLC.; Aquarius Bathware

B. General: PMMA shower enclosure with faucet and receptor and appurtenances.

1. Standard: ANSI Z124.1.2.
2. Type: One-piece unit without top .
3. Style: Handicapped/wheelchair.
4. Faucet: Single handle pressure balanced.
5. Nominal Size and Shape: 36 by 36 inches (915 by 915 mm) square.
6. Color: White
7. Bathing Surface: Slip resistant according to ASTM F 462.
8. Outlet: Drain with NPS 2 (DN 50) outlet.
9. Shower Rod and Curtain: Required.
10. Grab Bar: ASTM F 446, mounted on support area back wall.

2.2 SHOWER FAUCETS

A. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for shower materials that will be in contact with potable water.

B. Shower Faucets :

1. Manufacturers: Subject to compliance with requirements, *available* manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Standard America
b. Kohler Co.
c. Zurn Industries LLC, AquaSpec Commercial Faucet Products

2. Description: Single-handle, pressure-balance mixing valve with hot- and cold-water indicators; check stops; and shower head.

a. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016.
b. Body Material: Solid brass.
c. Finish: Polished chrome plate.
d. Maximum Flow Rate: 2.5 gpm (9.5 L/min.) unless otherwise indicated.
e. Mounting: Concealed.
f. Operation: Single-handle, twist or rotate control.
g. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.

3. Supply Connections: NPS ½ (DN 15) Shower head:

a. Standard: ASME A112.18.1/CSA B125.1

b. Type: Ball joint with arm and flange.

c. Shower Head Material: Metallic with chrome-plated finish

d. Spray Pattern: Adjustable

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before shower installation.

B. Examine walls and floors for suitable conditions where showers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble shower components according to manufacturers' written instructions.

B. Install showers level and plumb according to roughing-in drawings.

C. Install water-supply piping with stop on each supply to each shower faucet.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with shower. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."

2. Install stops in locations where they can be easily reached for operation.

D. Install shower flow-control fittings with specified maximum flow rates in shower arms.

E. Set shower receptors in leveling bed of cement grout.

F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheons requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

G. Seal joints between showers and floors and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with traps and soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust showers and controls. Replace damaged and malfunctioning showers, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of showers, inspect and repair damaged finishes.

B. Clean showers, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed fixtures and fittings.

D. Do not allow use of showers for temporary facilities unless approved in writing by Owner.

END OF SECTION 224223

SECTION 224500 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Combination units.
2. Water-tempering equipment.

B. RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d)(13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.
B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
C. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.
D. Tepid: Moderately warm.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1. Include construction details, material descriptions, dimension of individual components and profiles, and finishes.

C. Shop Drawings: Diagram power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.
B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For emergency plumbing fixtures to include in the operation and maintenance manuals

specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.

D. Regulatory Requirements: Comply with requirements in ICC/ANSI A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

PART 2 - PRODUCTS

2.1 COMBINATION UNITS

A. Accessible, Plumbed Emergency Shower with Eye/Face Wash Combination Units:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Acorn Safety; a division of Acorn Engineering Company.
   b. Bradley Corporation.
   c. Haws Corporation.
2. .Piping:
   a. Material: Galvanized steel.
   b. Unit Supply: NPS 1-1/4 minimum.
   c. Unit Drain: Outlet at back or side near bottom.
3. Shower:
   a. Capacity: Not less than 20 gpm for at least 15 minutes.
   b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.
   c. Control-Valve Actuator: Pull rod.
   d. Shower Head: 8-inch- minimum diameter, chrome-plated brass or stainless steel.
   e. Mounting: Pedestal.
4. Eye/Face Wash Unit:
   a. Capacity: Not less than 3 gpm for at least 15 minutes.
   b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
   c. Control-Valve Actuator: Paddle.
   d. Spray-Head Assembly: Two or four receptor-mounted spray heads.

e. Receptor: Chrome-plated brass or stainless-steel bowl.

f. Mounting: Attached to shower pedestal.

g. Drench-Hose Option: May be provided instead of eye/face wash unit.

1) Capacity: Not less than 3 gpm for at least 15 minutes.

2) Drench Hose: Hand-held spray head with squeeze-handle actuator and hose.

3) Mounting: Bracket on shower pedestal.

2.2 WATER-TEMPERING EQUIPMENT

A. Electric Water-Tempering Equipment, As scheduled:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Chronomite Laboratories, Inc.; a division of Acorn Engineering Company.

b. Eemax.

c. Bosch Water Heating

2. Description: Factory-fabricated equipment with electric heating.

a. Heating System: Electric, designed to provide 85 deg F tepid, potable water at emergency plumbing fixtures, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, heating coils, high-temperature- limit device, metal piping, and corrosion-resistant enclosure.

1) Electrical Characteristics: As scheduled.

2.3 SOURCE QUALITY CONTROL

A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency equipment.
2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.

E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Section 221116 "Domestic Water Piping."

F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

G. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be indirectly connected to drainage system. Comply with requirements for waste piping specified in Section 221316 "Sanitary Waste and Vent Piping."

H. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 CONNECTIONS

A. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water- tempering equipment. Comply with requirements for cold-water piping specified in Section 221116 "Domestic Water Piping."

B. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for hot- and cold-water piping specified in Section 221116 "Domestic Water Piping."

C. Connect cold water and electrical power to electric heating water-tempering equipment. Comply with requirements for cold-water piping specified in Section 221116 "Domestic Water Piping."

D. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary waste or storm drainage piping.

E. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.4 IDENTIFICATION

A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Emergency plumbing fixtures and water-tempering equipment will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION 224500

SECTION 224716 - PRESSURE WATER COOLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes pressure water coolers and related components.

B. RELATED SECTIONS

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a- 38k-4(d) (13):
2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of pressure water cooler.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. LEED Submittals:

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For pressure water coolers to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Spare Parts: For pressure water coolers specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1. 5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filter Cartridges: Equal to 10 percent of quantity installed for each type and size indicated, but no fewer than 2 of each.

PART 2 - PRODUCTS

2.1 PRESSURE WATER COOLERS

A. Pressure Water Coolers: Wall mounted, wheelchair accessible.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Elkay Manufacturing Co.
    b. Halsey Taylor.
    c. Haws Corporation.
2. Cabinet: Bi-level with two attached cabinets and with a bi-level skirt kit, vinyl-covered steel with stainless-steel top.
3. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.
4. Bottle filling station.
5. Control: Push bar.
6. Drain: Grid with NPS 1-1/4 tailpiece.
7. Supply: NPS 3/8 with shutoff valve.
8. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
9. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
10. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
    a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
11. Capacities and Characteristics:
    a. Cooled Water: 8 gph.
    b. Ambient-Air Temperature: 90 deg F.
    c. Inlet-Water Temperature: 80 deg F.
    d. Cooled-Water Temperature: 50 deg F.
    e. Electrical Characteristics:
        1) Motor Horsepower: 5 amps.
        2) Volts: 120-V ac.
        3) Phase: Single.
        4) Hertz: 60.
12. Support: ASME A112.6.1M, Type I water-cooler carrier.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children,

install at height required by authorities having jurisdiction.

B. Set freestanding pressure water coolers on floor.

C. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

D. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers to mounting frames.

E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."

F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball, gate, or globe shutoff valve on water supply to each fixture. Install valve upstream from filter for water cooler. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust pressure water-cooler temperature settings.

3.5 CLEANING

A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224716

SECTION 230000 GENERAL REQUIREMENTS FOR HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all HVAC work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5.

a The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 SCOPE OF WORK

A. Provide all labor, material, equipment, and services necessary for and incidental to completion of all work as indicated on the Drawings and/or as specified herein. This includes all incidentals, equipment, appliances, services, hoisting, scaffolding, supports, sleeves, inserts, anchor bolts, tools, supervision, labor, consumable items, fees, licenses, etc., necessary to provide complete and workable systems.

1.4 DRAWING USE AND INTERPRETATION

A. Unless indicated by specific dimensions, drawings are meant to be diagrammatic. Exact equipment locations and routing of utilities shall be governed by field conditions and/or Owner's Representative's instructions.

B. All dimensions which relate to the building shall be taken as construction progresses. All errors incurred as result of the failure to check or verify dimensions, measurements, etc., shall be corrected.

C. The drawings show the general arrangement of utilities, equipment, and accessories. Drawings do not indicate all offsets, fittings, accessories, and changes in elevation, which may be necessary. Make all changes in equipment, locations, etc., to accommodate the work and to avoid obstacles at no increase in contract price. Provide offsets, fittings, and accessories as may be required to meet such conditions.

1.5 SPECIFICATION FORMAT AND CONTENT EXPLANATION

A. Specification Content: This Specification uses certain conventions regarding the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:

1. Abbreviated Language: Language used in Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but

not stated, shall be interpolated as the sense requires. Singular words will be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.

2. Streamlined Language: The Specifications generally use the imperative mood and streamlined language. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the Text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor or by others when so noted.

a The words "shall be" are implied where a colon (:) is used within a sentence or phrase.

1.6 DEFINITIONS

A. General: Basic Contract definitions are included in the conditions of the Contract.

B. Indicated: The term "indicated" refers to graphic representations, notes or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.

C. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the Engineer," "requested by the Engineer," and similar phrases.

D. Approved: The term "approved," where used in conjunction with the Engineer's action on the Contractor's submittals, applications, and requests, is limited to the Engineer's duties and responsibilities as stated in the Conditions of the Contract.

E. Regulations: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

F. Furnish: The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."

G. Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."

H. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."

I. Installer: An "installer" is the Contractor or an entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

1. The term "experienced," when used with the term "installer," means having a minimum of five previous projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of the authority having jurisdiction.

2. Trades: Use of titles such as "carpentry" is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding

generic name, such as “carpenter.” It also does not imply that requirements specified apply exclusively to trades persons of the corresponding generic name.

3. Assignment of Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in the operations to be performed. The specialists must be engaged for those activities, and assignments are requirements over which the Contractor has no choice or option. Nevertheless, the ultimate responsibility of fulfilling Contract requirement remains with the Contractor.

a This requirement shall not be interpreted to conflict with enforcement of building codes and similar regulations governing the Work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.

J. The term “concealed”: embedded in masonry or other construction, installed behind wall furring, within partitions or hung ceilings (permanent or removable), in trenches, or in crawl spaces.

K. The term “exposed”: not installed underground or concealed. Equipment in rooms with exposed construction (i.e. mechanical rooms, electrical rooms, janitor’s closets, etc.) are classified as exposed.

L. The term “piping”: piping fittings, flanges, valves, controls, hangers, traps, drains, insulation and items necessary or required in connection with or relating thereto.

M. The “Project Site” is the space available to the contractor for performance of construction activities, either exclusively or in conjunction with other performing other work as part of the Project.

N. Testing Laboratories: A “testing laboratory” is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.7 COMPLETE SYSTEMS

A. General: Provide all materials as required for complete systems, including all parts obviously or reasonably incidental to a complete installation, whether specifically indicated or not. All systems shall be completely assembled, tested, adjusted and demonstrated to be ready for operation prior to Owner’s acceptance.

B. Systems: The systems specified and/or shown on the Drawings are for complete and workable systems. Any deviation from these systems due to a particular manufacturer’s requirements shall be made at no additional cost to the Owner.

1.8 CODES AND REGULATIONS

A. General: Comply with all governing federal, state, and local laws, ordinances, codes, rules, and regulations. Where the Contract Documents exceed these requirements, the Contract Documents shall govern. In no case shall work be installed contrary to or below minimum legal standards.

B. Utilities: Comply with all applicable rules, restrictions, and requirements of the utility companies serving the project site/facilities. Contractor shall be required to contact state regulated “call before you dig” service prior to any excavation work.

C. Non-Compliance: Should any work be performed which is found not to comply with any of the above codes and regulations, provide all work and pay all costs necessary to correct the deficiencies.

1.9 REFERENCE STANDARDS

A. All published standards of the following associations/organizations, as mandated by specific state standards, shall be followed and applied as a minimum.

AABC	Associated Air Balance Council
ACI	American Concrete Institute
AGA	American Gas Assoc.
AIA	The American Institute of Architects
AISC	American Institute of Steel Construction
AMCA	Air Movement and Control Assoc.
ANSI	American National Standards Institute
API	American Petroleum Institute
ARI	Air-Conditioning and Refrigeration Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Assoc.
CAGI	Compressed Air and Gas Institute
CGA	Compressed Gas Assoc.
CISPI	Cast Iron Soil Pipe Institute
DIPRA	Ductile Iron Pipe Research Assoc.
ETL	ETL SEMKO a Division of Intertek Group
FMG	Factory Mutual Global
GE-GAP	General Electric Global Assets Protection
HEI	Heat Exchange Institute
HI	Hydronics Institute
ISA	Instrument Society of America
MCAA	Mechanical Contractors Association of America
MSS	Manufacturers Standardization Society
NACE	National Association of Corrosion Engineers International
NADCA	National Air Duct Cleaners Association
NEC	National Electrical Code (from NFPA)
NECA	National Electrical Contractors Assoc.
NEMA	National Electrical Manufacturers Assoc.
NFPA	National Fire Protection Assoc.
NSF	National Sanitation Foundation
PDI	Plumbing and Drainage Institute
SMACNA	Sheet Metal and Air Conditioning Contractors
SSPMA	Sump and Sewage Pump Manufacturers Assoc.
STI	Steel Tank Institute
SWPA	Submersible Wastewater Pump Assoc.
UL	Underwriters Laboratories Inc.
WSC	Water Systems Council

B. Federal Government Agencies: Names and titles of federal government standard- or Specification-producing agencies are often abbreviated. The following acronyms or abbreviations referenced in the Contract Documents indicate names of standard- or Specification-producing agencies of the federal government. Names are subject to change and are believed, but are not assured, to be accurate and up-to-date as of the date of the Contract Documents.

CE	Corps of Engineers (U.S. Department of the Army)
EPA	Environmental Protection Agency
UFC	United Facilities Criteria
MIL	Military Standardization Documents (U.S. Department of Defense)
NIST	National Institute of Standards and Technology (U.S. Department of Commerce)
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor)

C. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference.

D. Copies of Standards: Each entity engaged in construction on the project is required to be familiar with industry standards applicable to that entity's construction activity. Copies of applicable standards are not bound with the Contract Documents. Where copies of standards are needed for performance of a required construction activity, the contractor shall obtain copies directly from the publication source.

1.10 QUALITY ASSURANCE

A. Manufacturers' Qualifications: Not less than five years experience in the actual production of the specified products.

B. Installers' Qualifications:

1. Firm with not less than five years experience in the installation of mechanical systems and equipment similar in scope and complexity to those required for this Project, and having successfully completed at least ten comparable scale projects.

2. Painting, patching, carpentry and the like related to or required for Division 23 work shall be performed by craftsman skilled in the appropriate trade.

3. All welding shall be performed by ASME certified welders.

1.11 INSPECTIONS

A. General: During and upon completion of the work, arrange and pay all associated costs for inspections of all work installed under this Contract, in accordance with the Conditions of the Contract.

B. Inspections Required: As per the laws and regulations of the local and/or state agencies having jurisdiction at the project site.

C. Inspection Agency: Approved by the local and/or state agencies having jurisdiction at the project site.

PART 2 - PRODUCTS

2.1 GENERAL

A. Where Specified: Materials and equipment shall be as specified in subsequent sections of the Project Manual and/or as indicated on the Drawings.

B. General: All materials and equipment to be new, clean, undamaged, and free of defects and corrosion.

C. Acceptable Products: The product will be acceptable only when that product complies with all requirements of the Contract Documents as determined by the Engineer.

D. Common Items: Where more than one of any specific item is required, all shall be of the same type and manufacturer.

E. Listing: All materials and equipment shall be Underwriters' Laboratories (UL) or ETL SEMKO (ETL) listed and labeled, where UL or ETL standards and listings exist for the specified materials or equipment.

F. Special Tools: Provide all special tools needed for proper operation, adjustment and maintenance of equipment.

PART 3 - EXECUTION

3.1 GENERAL

A. The installation of all mechanical work shall be in accordance with the letter and intent of the Contract Documents, as determined by the Engineer.

B. Installation Requirements: All materials and equipment shall be installed as recommended by the respective manufacturers, by mechanics experienced and skilled in their particular trade, in a neat and workmanlike manner, in accordance with the standards of the trade, and so as not to void any warranty, UL or ETL listing.

C. Should air handling units be used for temporary heat, the air filters in those air handling units shall be minimum MERV 10.

3.2 DELIVERY STORAGE AND HANDLING

A. Packing and Shipping: Deliver products in original, unopened packaging, properly identified with manufacturer's identification, and compliance labels.

B. Storage and Protection: Comply with all manufacturer's written recommendations. Protect all equipment, materials and work from the weather elements, paint, mortar, construction debris and damage throughout duration of project.

C. Damaged Products: Do not install damaged products. Arrange for prompt replacement.

3.3 EXAMINATION

A. Conditions Verification: Examine the areas and conditions under which the work is to be performed. Identify and Report any conditions detrimental to the proper and timely completion of the work to the Owner's Representative.

3.4 DIMENSIONS

A. Building Dimensions: Exact locations of building elements shall be based on contractor's field measurements.

B. Limiting Dimensions: Where equipment dimension and clearances are indicated on the Drawings, do not provide equipment larger than equipment dimensions or clearances specified.

C. Verify all dimensions by field measurements.

3.5 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

3.6 CUTTING AND PATCHING

A. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting and patching of mechanical equipment and materials required to:

1. Uncover Work to provide for installation of non-coordinated and/or improperly installed work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Remove samples of installed Work as specified for testing.
5. Install equipment and materials in existing structures.
6. Uncover and restore Work to provide for Engineer observation of concealed Work.

C. Cut, remove and legally dispose of equipment, components, and materials as indicated. Removal shall include all ancillary items associated with items removed. Remove all items made obsolete by the new work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated to be removed.

E. Provide and maintain temporary dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

F. Patch surfaces and building components using new materials matching existing adjacent materials.

3.7 ADMINISTRATION AND SUPERVISION

A. The Contractor shall supervise the work and shall have at all times some competent person, approved by the Owner, following the work to receive instructions and to act with authority.

3.8 TESTING AND ADJUSTING

A. General: Provide testing equipment, materials, instruments, and personnel to perform all test procedures and adjustments required by the Contract Documents and/or deemed necessary by the Engineer to establish proper performance and installation of systems and equipment. All test instruments to be accurately calibrated and in good working order.

B. Scheduling: Schedule tests at least three days in advance, and so as to allow Engineer and Owner representative(s) to witness the test, unless directed otherwise. Do not schedule tests until the system installation is complete and fully operational, unless indicated or directed otherwise.

C. Correction/Replacement: After testing, correct any deficiencies, and replace materials and equipment shown to be defective or unable to perform at design or rated capacity. Retest without additional cost to the Owner or Contract. Submit finalization report indicating corrective measures taken, and satisfactory results of retest.

3.9 SYSTEMS DEMONSTRATION

A. Instruct the Owner's representative(s) in the start-up, operation and maintenance of all systems and equipment in accordance with the Contract Documents.

3.10 CLEANING

A. General: Remove from the project site, all waste, rubbish and construction debris weekly unless indicated otherwise. The premises shall be left clean and free of any debris and unused construction materials, prior to final acceptance.

B. Equipment: Remove all dust, dirt, debris, mortar, rust, and other foreign materials from the interior and exterior of all equipment and enclosures, and wipe down.

C. Utilities: Thoroughly clean all utilities, just prior to final inspection.

3.11 TOUCH-UP PAINTING

A. Touch-Up Painting: Restore and refinish to original condition, all surfaces of equipment scratched, marred and/or dented during shipping, handling, or installation. Remove all rust, and prime and paint as recommended by the manufacturer.

END OF SECTION 230000

SECTION 230004 COORDINATION WITH OTHER TRADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section describes the coordination and procedural requirements for Contractors.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13.

2. HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

C. Definitions:

1. Owners Representative - Architect, Engineer, Construction Manager, General Contractor, Clerk of the works or any stipulated Agent or Representative of the Owner.

2. GC - General Contractor

3. MC - Mechanical Contractor/Subcontractor

4. PC - Plumbing Contractor/Subcontractor

5. EC - Electrical Contractor/Subcontractor

6. SM - Sheet Metal Subcontractor

7. SC - Sprinkler Contractor/Subcontractor

1.3 COMPLIANCE

A. Cost incurred including those of other contractors and/or Owner, due to non-compliance with this Section shall be the responsibility of the non-compliant contractor.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Shop Drawings: Complete coordinated shop drawing shall be submitted in PDF and ACAD format to the Engineer for their record by the MC. Submitted coordinated shop drawing shall include all signatures required by sign off procedure.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 COORDINATION

A. General: Sequence, coordinate and integrate the installation of all materials and equipment for efficient flow of work, in conjunction with the other trades. Review and become familiar with all of the Drawings and work of all the other trades. Report and resolve any discovered discrepancies and/or interferences prior to commencing work.

B. Cooperation: Cooperate with the other Contractors and individual disciplines for placement, anchorage and accomplishment of the work.

C. Chases, Slots, and Openings: Arrange for chases, slots, and openings during the progress of construction, as required to allow for installation of the work.

D. Supports and Sleeves: Coordinate the location installation of required supporting devices and sleeves to be set in concrete and other structural components, as they are constructed.

E. Right-Of-Way:

1. Adjust location of utilities, equipment, etc., to accommodate the work to prevent interferences, both anticipated and encountered.

2. Determine the exact route and location prior to fabrication.

3. Pitched piping has the right-of-way over utilities which do not pitch.

4. Furnish and install ansulary materials & equipment including but not limited to traps, air vents, drains, etc., as required to accommodate offsets, transitions and changes in direction.

F. Headroom: Install systems, materials, and equipment to maximize headroom unless noted otherwise.

G. Utility Connections: Coordinate connection with underground and overhead utility services. Comply with requirements of governing regulations, utility providers, and controlling agencies. Provide required connection for each service.

3.2 COORDINATED SHOP DRAWINGS

A. The coordination shop drawing process shall occur in the following manner:

1. The MC shall create 3/8" scale AutoCAD (2002 or newer) base plans which shall incorporate and coordinate with structural steel and ceiling system framing supports and show framing members on the shop drawings. This shall include existing building components not shown on Contract Documents.

2. The MC shall require the Sheet Metal Subcontractor to submit AutoCAD shop drawings, as expeditiously as possible, to the Engineer (through normal channels) for review and approval. The shop drawings shall incorporate all ductwork (including top and bottom of duct elevations at a maximum interval of 25 linear feet and at each elevation change), structural steel (building and misc. support steel), equipment and accessories as shown and/or specified in the contract documents.

3. All roof penetrations, wall and floor openings shall be coordinated with the structural steel Subcontractor, Supplier and/or Erector, through the Owner’s Representative. All conflicts with structural steel members shall be resolved through the Owner’s Representative.

4. After review and final approval of the sheet metal shop drawing by the Engineer, the sheet metal Subcontractor shall incorporate all required corrections, additions and modifications on the AutoCAD ductwork shop drawings.

5. The approved AutoCAD ductwork shop drawings shall be utilized for coordination with all other Contractors or Subcontractors whose involvement is mandated. The SM shall submit the AutoCAD ductwork shop drawings (hard copy and electronic files) to the MC to initiate the "coordination" process. The MC shall review the drawings for accuracy and completeness prior to distribution.

6. The MC shall forward, with transmittal, the ductwork shop drawings (hard copy and electronic files) to the PC for coordination of the plumbing work. The MC shall forward a copy of the transmittal to the Owner's Representative.

7. The PC shall (upon receipt of drawings from the MC) superimpose his scope of work on the AutoCAD ductwork shop drawings illustrating all plumbing equipment, piping and hangers.

8. The PC shall include invert of pipes; elevations (top and bottom) and pipe sizes including insulation at a maximum of 25 foot intervals and at each elevation change.

9. Any conflicts between the plumbing and ductwork shall be clouded by the PC on the AutoCAD ductwork shop drawing file.

10. PC shall request coordination meeting to resolve the conflicts as clouded on the coordinated shop drawings. PC shall provide clouded shop drawing at the coordination meeting. All conflicts that arise between the plumbing and ductwork shall be resolved through and by the Owner's Representative.

11. The PC and/or the SM shall correct and shall complete the AutoCAD drawings depicting all resolutions.

12. When it is ascertained that no conflicts exist between the ductwork and plumbing work, the PC shall forward the final ductwork/plumbing coordinated drawings (hard copy and electronic files) to the MC with transmittal, and provide the Owner's Representative with a copy of the transmittal.

13. The MC shall (upon receipt of drawings from the PC) superimpose all heating and air conditioning piping, equipment, hangers, and insulation, including elevations (top and bottom) and pipe sizes (including insulation), on the AutoCAD drawings.

14. Any conflicts between the ductwork/plumbing/mechanical work shall be clouded by the MC on the AutoCAD shop drawing file.

15. MC shall request coordination meeting to resolve the conflicts as clouded on the coordinated shop drawings. MC shall provide clouded shop drawing at the coordination meeting. All conflicts that arise between the MC, SM and PC shall be resolved through and by the Owner's Representative.

16. The MC, PC and SM shall correct and complete the AutoCAD drawings depicting all resolutions.

17. When it is ascertained that no conflicts exist between the MC, SM and PC, the MC shall forward the final ductwork/plumbing/mechanical coordinated drawings (hard copy and electronic files) to the EC with transmittal, and provide the Owner's Representative with a copy of the transmittal.

18. The EC shall (upon receipt of drawings from the MC) superimpose all electrical equipment including but not limited to light fixtures, conduit and hangers on the AutoCAD drawings.

19. The EC shall include elevations of light fixtures, electrical conduit and conduit sizes.

20. Any conflicts with the ductwork/plumbing/mechanical/electrical work shall be clouded by the EC on the AutoCAD shop drawing file.

21. EC shall request coordination meeting to resolve any conflicts as clouded on the coordinated shop drawings. EC shall provide clouded coordinated shop drawing at the coordination meeting. All conflicts that arise between the EC, MC, PC and SM shall be resolved through and by the Owner's Representative.

22. The EC and/or the SM, PC, MC shall correct and complete the AutoCAD drawings depicting all resolutions.

23. When it is ascertained that no conflicts exist between the EC, MC, PC and SM, the EC shall forward the final ductwork/plumbing/mechanical/electrical coordinated drawings (hard copy and electronic file) to the SC with transmittal, and provide the Owner's Representative with a copy of the transmittal.

24. The SC shall (upon receipt of drawings from the EC) superimpose all sprinkler equipment, piping, hangers and sprinkler heads as required by the contract documents and the appropriate codes.

25. The SC shall include elevations of piping and piping sizes.

26. Any conflicts with the ductwork/plumbing/mechanical/electrical/sprinkler work shall be clouded by the SC on the AutoCAD shop drawings.

27. The SC shall request coordination meeting to resolve any conflicts as clouded on the coordinated shop drawings. SC shall provide clouded coordinated shop drawing at the coordination meeting. All conflicts that arise between the SC, EC, MC, PC, and/or SM shall be resolved through and by the Owner's Representative.

28. The SC and/or EC, MC, PC, SM shall complete the AutoCAD drawings depicting all resolutions.

29. When it is ascertained that no conflicts exist between the SC, EC, MC, PC, and SM, the SC shall forward the final ductwork/plumbing/mechanical/electrical/sprinkler coordination drawing to the MC with transmittal, and provide the Owner's Representative with a copy of the transmittal.

30. Sign Off:

    a The MC shall provide the final coordinated shop drawing to the Engineer and the Owner's Representative. The final coordinated shop drawing shall contain signatures from SM, PC, MC, EC, and SC on each sheet.

    b Upon completion of the coordination process by all Contractors and Subcontractors as described above, they shall sign off on all drawings in ink indicating company, name, date of sign-off and signature of company representative.

    c Each contractor signature shall certify that each Contractor has shown their respective work on the drawings and have resolved all points of conflict and interference with other Contractors and Subcontractors.

3.3 COORDINATION MEETINGS

A. During the coordination process, separate meetings apart from project meetings concerning the progress and schedules may be called by the Owner's Representative when required or at the request of one or more of the coordinating Contractors.

1. The Owner's Representative shall contact the Contractors and make all required arrangements, e.g. time, place, etc.

2. All Contractors shall place emphasis and importance on equipment purchases, so as to not delay approvals, shop drawings and the coordinated drawings.

3.4 SCHEDULE OF COORDINATED SHOP DRAWINGS

A. The MC and SM shall complete the ductwork shop drawings within two (2) weeks after award of contract (or authorization to proceed).

B. Turn-around time for each Contractor shall be two (2) weeks maximum.

END OF SECTION 230004

SECTION 230500- BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes the following basic materials and methods to complement other Division 23 Sections.

1. Piping installation instructions common to most piping systems
2. Dielectric fittings
3. Flexible connectors
4. Mechanical sleeve seals
5. Sleeves
6. Escutcheons
7. Identifying devices and labels
8. Grout
9. Interior concrete housekeeping pads
10. Pipe enclosures
11. Installation requirements common to equipment specification sections
12. Touch-up painting
13. Repairs

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5.

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

C. Pipe, pipe fittings and joining materials and methods are specified in Division 23 piping system sections.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. NP: Nylon plastic.
4. HDPE: High Density Polyethylene plastic.
5. PVC: Polyvinyl chloride plastic.

G. Existing: Condition present prior to award of this contract.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For all materials specified within this section.

C. Fire Rated Penetration Listing Details: Submit Underwriters Laboratory penetration listing details specific to the penetrations required by the project along with fire stopping material data

1.5 INFORMATION SUBMITTALS

A. Quality Control Submittals: Fire stopping certificates specified in Quality Assurance below.

1.6 QUALITY ASSURANCE

A. Fire Stopping: Fire stopping installer shall be certified by the fire stopping manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Protect piping, flanges, fittings, and piping specialties to prevent pipe end damage. Maintain end caps through shipping, storage, and handling.

B. Store plastic pipes in locations not subject to direct sunlight.

C. Protect all stored materials from moisture and dirt. Elevate above grade and support to prevent sagging and bending. Do not exceed structural capacity of floor, if stored inside.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where identifying devices are to be applied.

B. Install identifying devices before concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Dielectric Components:

   a. Watts Water Technologies, Inc.
   b. Grinnell Corp.; Grinnell Supply Sales Co.
   c. Victaulic Co. of America.

2. Metal, Flexible Connectors:

   a. Flexicraft Industries.
   b. Grinnell Corp.; Grinnell Supply Sales Co.
   c. Metraflex Co.

3. Mechanical Sleeve Seals:

   a. Calpico, Inc.
   b. Metraflex Co.
   c. Proco Products, Inc.

4. Pipe Escutcheons:

   a. Chicago Specialty Mfg. Co.
   b. Sanitary-Dash Mfg. Co.
   c. Grinnell

5. Identifying Devices:

   a. Craftsmark Identification Systems
   b. Seton Identification Products
   c. W.H. Brady Company

2.1 DIELECTRIC FITTINGS

A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.

B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.

C. Insulating Material: Suitable for system fluid, pressure, and temperature.

D. Dielectric-Flange Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers. Dielectric flange kit materials shall be compatible with system fluid, temperature and pressure.

E. Dielectric Couplings: ARE NOT ALLOWED

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; and 300-psig (2070-kPa) minimum working pressure at 225° F (107° C). Coordinate end selection with piping system specifications.

2.2 FLEXIBLE CONNECTORS

A. General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 125-psig (860-kPa) minimum working-pressure rating at 220°F, unless higher working pressure or temperature is indicated. Coordinate end selection with piping system specifications.

B. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors (non-potable applications only): Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

2.3 MECHANICAL SLEEVE SEALS

A. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with stainless steel bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical isolation.

2.4 SLEEVES

A. General: The following materials are for wall, floor, slab and roof penetrations.

B. Pipe:

1. Steel Sheet Metal: 0.0359-inch (0.9-mm) minimum thickness, galvanized, round tube closed with welded longitudinal joint.

2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, and plain ends. Provide integral waterstop where indicated.

3. Cast Iron: Cast or fabricated pipe equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

a. Underdeck Clamp: Clamping ring with set screws.

C. Ductwork

1. All sleeves shall be per SMACNA.

2.5 ESCUTCHEONS

A. General: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.

1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
2. OD: Completely cover opening.
3. Stamped Steel: One piece, with set screw and chrome-plated finish.
4. Stamped Steel: Split plate, with concealed hinge, set screw, and chrome-plated finish.

2.6 IDENTIFYING DEVICES AND LABELS

A. Equipment Nameplates: Metal nameplate with operational data engraved or die-stamped; permanently fastened to equipment.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.

B. Stick-on Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl, complying with ASME A13.1.

C. Stick-on Duct Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl, complying with ASME A13.1.

D. Stick-on Flow Marker: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl, two inch (2") wide band, color coded complying with ASME A13.1.

E. Rigid Pipe Markers: Manufacturer's standard preprinted, color coded, rigid plastic with flow arrows and fluid medium designed to be applied to piping systems without the need of adhesives. For markers up to 6 inch, markers shall wrap completely around the pipe, and their own tension shall secure them in place. For markers over 6 inch, markers shall be provided with nylon ties to secure marker to piping system Markers comply with ANSI/ASME A13.1.

F. Valve Tags: Stamped or engraved 0.032-inch- (0.8-mm-) thick, polished brass, 1-1/2-inches (40-mm) diameter, with 1/4-inch (6-mm) piping system abbreviation letters and 1/2-inch (13-mm) sequenced numbers. Include 5/32-inch (4-mm) hole and brass, wire-link or beaded chain; or brass S-hook fastener.

G. Framed Valve Schedule: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include appropriate mounting hardware. Valve schedule shall be 8-1/2" x 11" with a minimum font height of 12 pt. Frame shall be extruded aluminum with ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass. Schedule shall include valve number, piping system, system abbreviation as shown on valve tag, location of valve (room or space), normal operating position (open, closed or modulating). Indicate valves utilized for emergency shut off or other special purposes.

H. Access Panel Markers: 1/16-inch- (2-mm-) thick, engraved plastic-laminate markers, with abbreviated terms and numbers corresponding to concealed valve. Provide 1/8-inch (3-mm) center hole for attachment

I. Plastic Equipment Markers: ASME A13.1, color-coded, laminated plastic. Include lettering identifying name, equipment service, design capacity, pressure drop, entering and leaving conditions and RPM indicated on the contract documents. Size shall be 2-1/2 by 4 inches (65 by 100 mm) for control devices, dampers, and valves; and 4-1/2 by 6 inches (115 by 150 mm) for equipment. Identifying names and/or abbreviations shall match those indicated on the contract documents.

2.7 GROUT

A. Non-shrink, Non-metallic Grout: ASTM C 1107, Grade B, post-hardening, volume-adjusting, dry, non-staining, non-corrosive, non-gaseous, hydraulic-cement grout recommended for interior and exterior applications. Design mix shall be 5000-psig (34.5-MPa), 28-day compressive strength.

2.8 INTERIOR CONCRETE HOUSEKEEPING PADS

A. Concrete: 3000-psig (20.7-MPa), 28-day compressive-strength concrete.

B. Form work: 14 gauge galvanized steel frame

C. Dowels: #4 rebar

D. Reinforcement: 6 X 6 –W2.9 X W 2.9 wire metal mesh at center

2.9 PIPE ENCLOSURES

A. 16 gage galvanized steel enclosures, color by architect, secured to walls, sized to conceal piping, insulation and supports. Provide single length with matching color screw heads.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. General: Install piping as described below, unless piping sections specify otherwise.

B. General Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.

C. Install components with pressure and temperature ratings equal to or greater than system operating pressure and temperature.

D. Install piping free of sags and bends. Install fittings for changes in direction and branch connections. Install fittings, couplings, and accessories according to manufacturer's written instructions.

E. Install piping at parallel and perpendicular to building walls. Diagonal runs are prohibited, unless otherwise indicated. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

F. In areas of exposed piping, install piping to maximize headroom. In areas with ceilings, install piping to maximize clearance between ceiling and pipe. Allow sufficient space for ceiling panel removal.

G. Install piping to allow application of insulation plus 1-inch (25-mm) clearance around insulation.

H. Install pipe escutcheons for pipe penetrations of walls, partitions, floors and ceilings.

I. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, ¾" ball valve, threaded nipple and chained cap.

J. Install line size manual shutoff valve at each connection to each piece of equipment.

K. Install piping so that accessories are accessible for operation, maintenance, repair and replacement.

L. Install piping with sufficient clearance to allow for expansion and contraction.

M. Sleeves are not required for core drilled holes through interior solid concrete walls and floors, above grade exterior solid concrete walls and existing underground solid concrete walls. Floors in mechanical equipment areas or other wet areas shall be provided with a sleeve with waterstop.

N. Install sleeves for pipes passing through walls, partitions, and slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. In floors with water stop extend cast-iron sleeve fittings below floor slab as required to secure clamping ring.

2. Build sleeves into new walls and slabs as walls and slabs are being constructed.

3. Install sleeves in non-fired rated assemblies large enough to provide 1/2-inch (12.7-mm) annular clear space between sleeve and pipe or pipe insulation.

4. Install sleeves in fire rated assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

O. Interior Wall and Floor Pipe Penetrations: Sleeves shall be steel pipe except steel sheet metal shall be used for gypsum wall penetrations.

P. Water Proof Floor and Roof Pipe Penetrations: For pipes penetrating floors and roofs with membrane waterproofing install stack sleeve fitting. Secure flashing between clamping flanges. Seal space outside of sleeve fittings with non-shrink, non-metallic grout. Provide Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant between sleeve and pipe.

Q. Aboveground, Exterior-Wall, Pipe Penetrations:

1. Masonry Wall: Provide steel pipe wall sleeve. Seal space outside of sleeve with non-shrink, non-metallic grout. Provide Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant between sleeve and pipe.

2. Non-Masonry or Non-Concrete Walls: Provide wall plate matching surrounding construction. Fill gap between wall opening and pipe with mineral wool. Provide Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant between wall plate and wall.

R. Underground, Exterior-Wall, Pipe Penetrations: Provide cast-iron or galvanized steel sleeves with integral waterstop, except for existing walls. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for annular clear space between pipe and sleeve for installing mechanical sleeve seals. Annular clear space shall be per mechanical sleeve seal manufacturer's written recommendation. Assemble and install mechanical sleeve seals according to manufacturer's written instructions.

S. Verify final equipment locations for roughing-in.

T. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:

1. Threaded Steel Pipe Joints: Thread pipe with tapered pipe threads in accordance with ANSI B2.1 and ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than 3 threads exposed. Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds

2. Welded Steel Pipe Joints: Weld pipe joints in accordance with applicable ASME Codes and AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe".

3. Flanged Steel Pipe Joints: Clean flange faces and install gaskets. Align flange surfaces parallel. Use suitable lubricants on bolt threads. Tighten bolts to torque specified by manufacturer of flange and flange bolts, to provide uniform compression of gaskets.

4. Grooved Steel Pipe Joints: Install per grooved piping manufacturer's written installation instructions.

5. Copper Pipe Joints: Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.

6. Gasket Materials: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.

7. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

8. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

9. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following:

   a. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

   b. ABS Piping: ASTM D 2235 and ASTM D 2661.

   c. CPVC Piping: ASTM D 2846 and ASTM F 493.

   d. PVC Pressure Piping: ASTM D 2672.

   e. PVC Nonpressure Piping: ASTM D 2855.

   f. PVC to ABS Nonpressure Transition Fittings: Procedure and solvent cement according to ASTM D 3138.

10. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657 procedures and manufacturer's written instructions.

    a. Plain-End Pipe and Fittings: Use butt fusion.
    b. Plain-End Pipe and Socket Fittings: Use socket fusion.

U. Piping Connections: Make connections according to the following, unless otherwise indicated:

1. Remake leaking joints using new materials.

2. Install unions, in piping 2-inch NPS (DN50) and smaller, adjacent to each valve and at final connection to each piece of equipment.

3. Install flanges, in piping 2-1/2-inch NPS (DN65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

4. Piping Systems: Install dielectric fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting and without interference(s) to other installations.

D. Extend grease fittings to accessible locations.

3.3 LABELING AND IDENTIFYING

A. Piping Systems: Install pipe markers on all piping of each system (insulated and un-insulated), including pipe sizes, fluid medium and direction of flow arrows.

1. Interior, non-metal jacketed piping systems: Provide stick-on markers. Install flow marker 360 degrees at each end of each pipe marker.

2. Interior metal jacketed and exterior piping systems: Provide rigid markers (for markers on piping over 6 inches provide nylon ties). Provide stick-on size marker attached to rigid marker.

3. Markers shall be spaced at a maximum of 25-foot (7.5-m) intervals along each run. In addition to the 25 foot intervals, provide markers at the following locations:

a. Near each valve and control device.

b. Near each branch, excluding short takeoffs for fixtures and terminal units.

c. Near locations where pipes pass through walls, floors, ceilings, or enter non-accessible enclosures.

d. At access doors, manholes, and similar access points that permit view of concealed piping.

e. Near major equipment items and other points of origination and termination.

B. Valve Tags

1. Install on all valves and control devices (factory and field installed), except check valves. List tagged valves in valve schedule.

2. Provide framed valve schedule(s) where directed by owners representative.

C. Install plastic equipment marker on all equipment provided under this contract.

D. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers. Duct markers shall identify service and direction of flow. Locate markers at maximum intervals of 50 feet (15m), near points where ducts enter and exit the space, and on ducts located behind all access doors.

E. Provide additional mechanical identification materials and devices to supplement field or factory supplied nameplates that have become visually blocked by work of this or other Divisions.

F. Clean faces of identification devices and glass frames of valve charts.

3.4 TOUCH-UP PAINTING

A. Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.5 GROUTING

A. Install nonmetallic, non-shrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix and cure grout according to manufacturer's written instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placing of grout.

E. Place grout to provide smooth bearing surface for equipment base.

F. Place grout, completely filling equipment bases.

G. Place grout around anchors.

3.6 INTERIOR CONCRETE HOUSEKEEPING PADS

A. Provide concrete housekeeping pads for all floor mounted equipment. Provide 6” tall 3000 psi concrete pad having 6 X 6 –W2.9 X W 2.9 wire metal mesh at center. Extend pad a minimum of 4” greater than equipment footprint in all directions. Provide a smooth trowel finish on top surface of pad.

B. Provide 14 gauge galvanized steel frame around entire perimeter of pad having a ¾” chamfer at all corners and at all edges. Frame to extend ½” over top of pad and 1” beneath bottom surface of pad. All corners to be welded.

C. Anchor pad to existing or new concrete floor with #4 rebar dowels set at a minimum 12” on center in each direction, having the last 2” of dowel bent at a 90 degree angle.

1. Existing floors: Drill 1” diameter bores into the existing concrete floor at a minimum depth of 2” to accept dowels. Fasten dowels within bores with epoxy grout.

2. Newly poured floors: Provide rebar dowels embedded to a depth of 2” below floor surface, having the last 2” of dowel bent at a 90 degree angle.

D. Prior to pouring concrete pad, place manufacture’s recommended galvanized steel anchor bolts into pad using the equipment template provided.

E. Provide 5000 psi level grout bedding beneath equipment prior to setting and final tightening of fasteners.

3.7 REPAIRS

A. If new work is damaged or disturbed, remove damaged sections and install new products of equal capacity and quality.

END OF SECTION 230500

SECTION 230513 ELECTRICAL REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This section specifies the basic requirements for electrical components which are furnished with mechanical equipment (factory or field installed).

1.3 REFERENCES

A. NEMA Standards MG 1: Motors and Generators

B. NEMA Standards ICS 2: Industrial Control Devices, Controllers, and Assemblies.

C. NEMA Standard 250: Enclosures for Electrical Equipment

D. NEMA Standard KS 1: Enclosed Switches

E. Comply with National Electrical Code (NFPA 70).

1.4 ACTION SUBMITTALS

A. Factory furnished electrical component product data submittal requirements are specified within the individual equipment specification sections.

1.5 QUALITY ASSURANCE

A. Electrical components and materials shall be UL or ETL labeled.

PART 2 - PRODUCTS

2.1 MOTORS

A. Electrical Characteristics shall meet the following unless otherwise indicated:

1. Frequency Rating: 60 HZ

2. Voltage Rating: Determined by voltage of circuit to which motor is connected for the following motor voltage ratings (utilization voltages):

a. 120V circuit: 115V motor rating.
b. 208V circuit: 200V motor rating.
c. 240V circuit: 230V motor rating.
d. 480V circuit: 460V motor rating.

B. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.

1. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.

C. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors, unless otherwise indicated.

D. Temperature rating: Rated for 40°C (104°F) environment.

E. Temperature rise: Rated for maximum of 90°C (194°F) rise for continuous duty at full load, Class B insulation, except for inverter duty rated motors which shall use Class F insulation.

F. Starting capability: Frequency of starts as required to meet automatic control system sequence of operation, and not less than 5 evenly timed starts per hour.

G. Capacity: Sufficient to start and operate connected loads without exceeding name plate ratings.

H. Motor construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B," except "C" where required for high starting torque.

1. Bearings:

a. re-greasable, except permanently sealed motor;

b. designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor;

2. Mounting:

a. horizontal: foot mounted
b. vertical: base mounted

3. Enclosure Type: See individual equipment specifications for enclosure type.

4. Lifting Lug: lifting eye or lug for all motors exceeding 50 pounds.

5. Stamped Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, efficiency, special features and similar information.

6. All motors 1hp and larger shall be premium efficiency, constant speed, rpm as specified, squirrel cage, unless otherwise required to meet driven equipment's maximum starting duty. Minimum full-load nominal efficiencies per IEEE Standard 112, Test Method B shall be equal to or greater than those listed in the following tables.

I. Polyphase Motors:

1. General: Squirrel-cage induction-type conforming to the following requirements except as otherwise indicated.

2. Variable Speed Motors for Use With Solid-State Drives: Energy efficient, invertor ready, design B units with ratings, characteristics, and features coordinated with drive manufacturer.

3. Bearings: Suitable for radial and thrust loading of the application.

4. Severe Duty Motors: Minimum 1.25 service factor. Provide motors with regreasable bearings and equipped with capped relief vents. Insulate windings with nonhygroscopic material.

5. Motors for Reduced Inrush Starting: Coordinate with reduced inrush controller type and with characteristics of driven equipment load. Provide required wiring leads in motor terminal box to suit control method.

J. Single-Phase Motors:

1. Energy Efficient Motors: One of the following types as selected to suit the starting torque and other requirements of the specific motor application.

   a. Permanent Split Capacitor.
   b. Split-Phase Start, Capacitor-Run
   c. Capacitor-Start, Capacitor-Run
   d. Shaded-Pole.
   e. Capacitor Start, Induction Run.

2. Internal Thermal Overload Protection for Motors: Protection shall automatically open the power supply circuit to the motor, or a control circuit. Protection shall operate when winding temperature exceeds a safe value calibrated to the temperature rating of the motor insulation. Motor shall automatically reset when motor temperature returns to normal range.

3. Bearings: Belt connected motors or other motors with high radial forces on motor shaft shall be ball bearing type. Sealed, prelubricated sleeve bearings may be used for other single phase motors.

2.2 STARTERS, DISCONNECTS AND ACCESSORIES

A. Motor Starter Characteristics:

1. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition. Minimum size starter shall be NEMA Size 1.

B. Manual Disconnect Switches:

1. Fusible switches: fused, each phase; general duty; horsepower rated; non-teasible quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the “OPEN” position; arc quenchers; capacity and characteristics as required by equipment manufacturer.

2. Non-fusible switches: horsepower rated toggle switch type; quantity of poles and voltage rating as required by equipment manufacturer.

C. Magnetic Starters:

1. Hand-off-auto, selector switches and pilot lights.

2. Trip-free thermal overload relays, each phase.

3. Interlocks, switches, contacts and similar devices as required for coordination with control requirements.

4. Built-in control circuit transformer, sized by manufacturer. Provide with minimum two normally-open and two normally closed spare auxiliary contacts.

5. Externally operated manual reset.

6. High voltage and low voltage protection in all three phases.

7. Internal Thermal Overload Protection For Motors: Protection shall automatically open control circuit. Protection shall operate when winding temperature exceeds safe value calibrated to the temperature rating of the motor insulation.

D. Starter Enclosures:

1. NEMA rated as required for environment in which equipment is to be installed.

2. Interlock covers of combination starters with operating handle providing access to inside of enclosure only when disconnect is in “OFF” position. Provide means to attach multiple padlocks for locking external operating handle in either the “ON” or “OFF” position.

3. Provide red colored RESET Button in cover of starter.

4. Provide and secure wiring diagram corresponding to motor and control wiring of associated equipment on inside of each magnetic and combination starter.

5. Manual starter shall have means for externally locking operating mechanism in “OFF” position.

E. Factory Installed Motor Connections:

1. Flexible conduit, except where plug-in electrical cords are specifically indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Motors: Install field-installed motors in accordance with manufacturer’s published instructions and the following:

1. Direct Connected Motors: Mount securely in accurate laser alignment.

2. Belt Drive Motors: Use adjustable motor mounting bases. Align pulleys and install belts. Use belts identified by the manufacturer and tension belts in accordance with manufacturer recommendations.

3. Bearings: Provide extended lube lines for regreasable motors.

B. Motor Controllers (starters, Disconnects and Drives): Install field-installed starters, disconnects and drives in accordance with manufacturer’s published instructions and the following:

1. Locate controllers within sight of motors controller.

2. Mounting: For control equipment at walls, bolt units to wall or mount on light-weight structural steel channels bolted to the wall. For controllers not at walls, provide freestanding racks fabricated of structural steel members and light-weight slotted structural steel channels. Use feet consisting of 3/8-inch thick steel plates, 6 inch square, bolted to the floor. Use feet for welded attachment of 1-1/2-inch thick steel plates, 6 inch square, bolted to the floor. Use feet for welded attachment of 1-1/2-inch by 1-1/2-inch by 1/4 –inch vertical angle pots not over three feet on centers. Connect the posts with horizontal lightweight slotted steel channels and bolt the control equipment to the channels.

3. Clearances: All motor controllers shall be installed per NEC requirements.

3.2 ACCEPTANCE

A. The right is reserved by the Owner's Representative to reject any motor which, in his opinion, either under test or in actual service is found to be overloaded, develops excessive mechanical noise, magnetic hum, or otherwise operates unsatisfactorily, within the speed range and load specified. The contractor shall adjust, or if necessary replace any such deflected motor with one satisfactory to the Owner or Owner's Representative without any extra cost to the Owner.

END OF SECTION 230513

SECTION 230516 PIPE EXPANSION JOINTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes pipe expansion joints, guides, and anchors for mechanical piping systems.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5.

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 PERFORMANCE REQUIREMENTS

A. Compatibility: Provide pipe expansion joints, pipe alignment guides, and pipe anchors suitable for piping system fluids, materials, working pressures, and temperatures.

B. Fabricate and install expansion and anchor system capable of sustaining forces generated by gravity, thermal movement, and seismic events.

C. Design and obtain approval from authority with jurisdiction, seismic restraints for pipe expansion joints and pipe anchor system.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of pipe expansion joint and pipe alignment guide.

C. Schedule: Pipe expansion joint schedule showing manufacturer' figure number, size, location, and features for each required expansion joint.

D. Shop Drawings: Assembly-type shop drawings for each type of pipe expansion joint, pipe alignment guide, and anchor, indicating dimensions, weights, required clearances, and methods of component assembly.

1.5 INFORMATION SUBMITTALS

A. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type pipe expansion joint to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For each type pipe expansion joint manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 QUALITY ASSURANCE

A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code-Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications'

C. Licensed Engineer's Design Drawings and Calculations: Design and prepare drawings and calculations for seismic restraint of pipe expansion joints, pipe alignment guides, and pipe anchors. Include seal and signature of Registered Engineer, licensed in jurisdiction where Project is located, certifying compliance with specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Pre-fabricated Flexible Expansion Loops

a. The Metraflex, Co. – "Metraloop"
b. Flexicraft Industries
c. Hyspan Precision Products, Inc.

2. Pipe Alignment Guides:

a. Hyspan Precision Products, Inc.
b. Keflex, Inc.
c. Metraflex Co.

2.2 PIPE EXPANSION JOINTS, GENERAL

A. Capability: Absorb 200 percent of maximum piping expansion between anchors.

2.3 PRE-FABRICATED FLEXIBLE EXPANSION LOOPS

A. Flexible loops shall be Stainless Steel hose and braid with 150 lb. Flanged, weld or grooved ends . Flexible loops shall be designed to impart no thrust loads on the anchors. The loop shall consist of two flexible sections of hose and braid, two 90 deg. Elbows, and a 180 deg. Return. Loops shall be installed in a neutral, precompressed or preextended condition as required for the application. Install loops, anchors (anchors for thrust loads shall not be required) and guides as per manufacturer's installation instructions and recommendations.

2.4 PIPE ALIGNMENT GUIDES

A. Factory-fabricated cast semisteel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base. Include two-section guiding spider that bolts tightly to the pipe.

1. Alignment Guide Lengths: As required for indicated travel.

2.5 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.

C. Washers: ASTM F 844, steel, plain, flat washers.

D. Powder-Actuated Fasteners: Attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

E. Concrete: Portland-cement mix, 3000 psi (20.7 MPa).

1. Cement: ASTM C 150, Type I.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

F. Grout: ASTM C 1107, Grade B, nonshrink, nonmetallic.

1. Characteristics include post-hardening volume-adjusting dry hydraulic-cement-type grout that is nonstaining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.

2. Design Mix: 5000 psi (34.5 MPa), 28-day compressive strength.

3. Water: Potable.

4. Packaging: Premixed and factory-packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which pipe expansion joints, pipe alignment guides, and pipe anchors are to be installed. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PIPE EXPANSION JOINT INSTALLATION

A. Install pipe expansion joints according to manufacturer’s written instructions.

B. Align expansion joints to avoid end-loading and torsional stress.

3.3 FABRICATED-TYPE PIPE EXPANSION COMPENSATION INSTALLATION

A. Install pipe expansion loops cold-sprung in tension or compression as required to absorb 50 percent of total compression or tension that will be produced during anticipated change in temperature.

B. Connect risers to mains with at least 5 pipe fittings including tee in main.

C. Connect risers to terminal units with at least 4 pipe fittings including tee in riser.

3.4 PIPE ALIGNMENT GUIDE INSTALLATION

A. Install pipe alignment guides on piping that adjoins pipe expansion joints per the pipe expansion joint manufacturer's written instructions.

B. Install pipe alignment guides on piping that adjoins pipe expansion loops.

C. Install pipe alignment guides on piping elsewhere as indicated.

D. Secure pipe alignment guides to building substrate.

3.5 PIPE ANCHOR INSTALLATION

A. Install pipe anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and with AWS D1.1.

C. Construct concrete pipe anchors of poured-in-place concrete of dimensions indicated.

D. Where pipe expansion joints are indicated, install pipe anchors according to expansion unit manufacturer's written instructions to control movement to compensators.

E. Pipe Anchor Spacings: Where not otherwise indicated, install pipe anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends. Preset anchors as required to accommodate both expansion and contraction of piping.

F. Use grout to form flat bearing surfaces for pipe expansion joints, pipe alignment guides, and pipe anchors that are installed on or in concrete.

3.6 FIELD QUALITY CONTROL

A. Licensed Engineer's Installation Report: Prepare report covering installation of pipe expansion joints, pipe alignment guides, and pipe anchors. Include seal and signature of Registered Engineer, licensed in jurisdiction where Project is located, certifying compliance with specifications.

END OF SECTION 230516

SECTION 230519 METERS AND GAGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes the following types of meters and gages:

1. Temperature gages and fittings.
2. Pressure gages and fittings.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter and gage schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gage.

1.4 INFORMATION SUBMITTALS

A. Product certificates signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and products' compliance with specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of meter and gage to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For each type of meter and gage specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. UL Compliance: Comply with applicable UL standards pertaining to meters and gages.

B. ASME and ISA Compliance: Comply with applicable portions of ASME and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Liquid In Glass Thermometers:

1. Trerice (H.O.) Co.
2. Weiss Instruments, Inc.
3. Weksler Instruments Corp.

B. Direct-Mount Filled-System Dial Thermometers:

1. Trerice (H.O.) Co.
2. Weiss Instruments, Inc.
3. Weksler Instruments Corp.

C. Thermometer Wells: Same as for thermometers.

D. Insertion Dial Thermometers:

1. Trerice (H.O.) Co.
2. Weiss Instruments, Inc.
3. Weksler Instruments Corp.

E. Pressure Gages:

1. Trerice (H.O.) Co.
2. Weiss Instruments, Inc.
3. Weksler Instruments Corp.

F. Pressure Gage Accessories: Same as for pressure gages.

G. Test Plugs:

1. Sisco, A Spedco, Inc. Co.
2. Trerice (H.O.) Co.
3. Watts Regulator Co.

2.2 THERMOMETERS, GENERAL

A. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span

B. Scale range: Temperature ranges for services listed as follows:

1. General: Temperature range shall be selected such that normal operating temperature is at 75% of scale.

2. Hot Water: 30 to 300°F with 2-degree scale divisions (0 to 150°C with 1-degree scale divisions).

2.3 LIQUID-IN-GLASS THERMOMETERS

A. Case: Die cast, aluminum finished, in baked epoxy enamel, glass front, spring secured, 9 inches long.

B. Adjustable Joint: Finished to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

C. Tube: Red reading, liquid filled, magnifying lens.

D. Scale: Satin-faced, nonreflective aluminum, with permanently etched markings.

E. Stem: Copper-plated steel, aluminum or brass, for separable socket, length to suit installation.

2.4 DIRECT-MOUNT FILLED-SYSTEM DIAL THERMOMETERS

A. Type: Vapor actuated, universal angle.

B. Case: Drawn steel or cast aluminum, glass lens, 4-1/2-inch diameter.

C. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

D. Thermal Bulb: Copper with phosphor bronze bourdon pressure tube.

E. Movement: Brass, precision geared.

F. Scale: Progressive, satin faced, nonreflective aluminum, permanently etched markings.

G. Stem: Copper-plated steel, aluminum, or brass, for separable socket, length to suit installation.

2.5 DIAL-TYPE INSERTION THERMOMETERS

A. Type: Bimetal, stainless steel case and stem, 1-inch-diameter dial, dust- and leakproof, 1/8-inch-diameter tapered-end stem with nominal length of 5 inches.

2.6 THERMOMETER WELLS

A. Thermometer Wells: Brass or stainless steel, pressure rated to match piping system design pressure; with 2-inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap.

2.7 PRESSURE GAGES

A. Type: General use, ASME B40.1, Grade A, phosphor bronze bourdon- tube type, bottom connection.

B. Case: Drawn steel or brass, glass lens, 4-1/2-inches diameter.

C. Connector: Brass, 1/4-inch NPS.

D. Scale: White coated aluminum, with permanently etched markings.

E. Accuracy: Plus or minus 1 percent of range span.

F. Range: Conform to the following:

1. Vacuum: 30 inches Hg to 15 psi.
2. All fluids: 2 times operating pressure.

2.8 PRESSURE GAGE ACCESSORIES

A. Syphon: 1/4-inch NPS straight coil constructed of brass tubing with threads on each end.

B. Snubber: 1/4-inch NPS brass bushing with corrosion-resistant porous metal disc. Disc material shall be suitable for fluid served and rated pressure.

2.9 TEST PLUGS

A. Test Plugs shall be nickel-plated brass body, with 1/2-inch NPS fitting and 2 self-sealing valve-type core inserts, suitable for inserting a 1/8-inch O.D. probe assembly from a dial-type thermometer or

pressure gage. Test plug shall have gasketed and threaded cap with retention chain and body of length to extend beyond insulation. Pressure rating shall be 500 psig.

B. Core Material: Conform to the following for fluid and temperature range:

1. Air, Water, Oil, and Gas, 20 to 200°F (minus 7 to 93°C): Neoprene.
2. Air and Water, minus 30 to 275°F (minus 35 to 136°C): EPDM.

C. Test Kit: Provide test kit consisting of 1 pressure gage, gage adapter with probe, 2 bimetal dial thermometers, and carrying case.

D. Ranges of pressure gage and thermometers shall be approximately 2 times systems operating conditions.

PART 3 - EXECUTION

3.1 THERMOMETERS INSTALLATION

A. Install thermometers in vertical and tilted positions to allow reading by observer standing on floor.

B. Install in the following locations and elsewhere as indicated:

1. At inlet and outlet of each hydronic zone.
2. At inlet and outlet of each hydronic boiler.
3. At inlet and outlet of each hydronic coil in air-handling units and rooftop units.
4.

C. Thermometer Wells: Install in piping tee where thermometers are indicated, in vertical position. Fill well with oil or graphite and secure cap.

3.2 INSTALLATION OF PRESSURE GAGES

A. Install pressure gages in piping tee with pressure gage valve, located on pipe at most readable position.

B. Install in the following locations, and elsewhere as indicated:

1. At suction and discharge of each pump.

C. Pressure Gage Needle Valves: Install in piping tee with snubber. Install syphon in lieu of snubber for steam pressure gages.

3.3 INSTALLATION OF TEST PLUGS

A. Test Plugs: Install in piping tee where indicated, located on pipe at most readable position. Secure cap.

3.4 ADJUSTING AND CLEANING

A. Adjusting: Adjust faces of meters and gages to proper angle for best visibility.

B. Cleaning: Clean windows of meters and gages and factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer’s touch-up paint.

3.5 CONNECTIONS

A. Piping installation requirements are specified in other sections. The drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:

1. Install meters and gages piping adjacent to machine to allow servicing and maintaining of machine.

END OF SECTION 230519

SECTION 230523 VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. Section includes: This section includes general duty valves common to most mechanical piping systems. Special purpose valves are specified in individual piping system specifications.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances.

C. Valve Schedule: Valve schedule indicating manufacturer's figure number, size, location, and valve features for each required valve, and installation instructions.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each valve to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For each valve manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 QUALITY ASSURANCE

A. American Society of Mechanical Engineers (ASME) Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

B. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the various MSS Standard Practices referenced.

1.6 QUALITY ASSURANCE SUBMITTALS

A. Manufacturer's Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.7 STORAGE AND HANDLING

A. Storage: Use the following precautions during storage:

1. Do not remove valve end protectors unless necessary for inspection; then reinstall for storage.

2. Protect valves from weather. Store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.

B. Handling: Use a sling to handle valves whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products from one of the manufacturers listed in valve schedule.

B. Provide valves of same manufacturer throughout where possible. Manufacturer's name, valve size, and pressure rating shall be clearly marked on outside of body.

2.2 VALVE FEATURES, GENERAL

A. Valve Design: Rising stem or rising outside screw and yoke stems.

1. Non-rising stem valves may be used where headroom prevents full extension of rising stems.

B. Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.

C. Sizes: Same size as upstream pipe, unless otherwise indicated.

D. Operators: Provide the following special operator features:

1. Handwheels, fastened to valve stem, for valves other than quarter turn.

2. Lever handles, on quarter-turn valves 6-inch and smaller, except for plug valves. Provide plug valves with square heads; provide one wrench for every 10 plug valves.

3. Gear drive operators, on quarter-turn valves 8-inch and larger.

E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

F. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.

G. End Connections: As indicated in the valve specifications.

1. Threads: Comply with ANSI B1.20.1.

2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.

3. Solder-Joint: Comply with ANSI B16.18.

a. Caution: Where soldered end connections are used, use solder having a melting point below 840EF for gate, globe, and check valves; below 421EF for ball valves.

2.3 BALL VALVES

A. Ball Valves, 1 Inch and Smaller: Rated for 150 psi saturated steam pressure, 600 psi WOG pressure; two-piece construction; with bronze body conforming to ASTM B 62, standard (or regular) port, chrome-plated brass ball, replaceable “Teflon” or “TFE” seats and seals, blowout-proof stem, and vinyl-covered steel handle. Provide solder ends for condenser water, chilled water, and domestic hot and cold water service; threaded ends for heating hot water.

B. Ball Valves, 1-1/4-Inch to 2 Inch: Rated for 150 psi saturated steam pressure, 400 psi WOG pressure; 3-piece construction; with bronze body conforming to ASTM B 62, full port, stainless steel ball, replaceable “Teflon” or “TFE” seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide solder ends for condenser water, chilled water, and domestic hot and cold water service; threaded ends for heating hot water and low-pressure steam.

C. Ball Valves, 2-1/2-Inch and Up: Rated for 150 psi saturated steam pressure, 400 psi WDG pressure; 3 piece construction; with carbon steel body conforming to ASTM-A216 WCB, full port, stainless steel ball, replaceable “Teflon” or “TFE” seats and seals, blowout proof stem, and vinyl covered steel handle - flanged ends.

2.4 GLOBE VALVES

A. Globe and Globe Angle Valves, 2-Inch and Smaller: MSS SP-80; Class 125; body and screwed bonnet of ASTM B 62 cast bronze; with threaded or solder ends, brass or replaceable composition disc, copper-silicon alloy stem, brass packing gland, “Teflon" impregnated packing, and malleable iron handwheel. Provide Class 150 valves meeting the above where system pressure requires.

B. Globe and Globe Angle Valves, 2-1/2-Inch and Larger: MSS SP-85; Class 125 iron body and bolted bonnet conforming to ASTM A 126, Class B; with outside screw and yoke, bronze mounted, flanged ends, and “Teflon” impregnated packing, and two-piece backing gland assembly.

2.5 BUTTERFLY VALVES

A. Butterfly Valves, 2-1/2-Inch and Larger: MSS SP-67; rated at 200 psi; cast-iron body conforming to ASTM A 126, Class B. Provide valves with field replaceable EPDM sleeve, nickel-plated ductile iron disc (except aluminum bronze disc for valves installed in condenser water piping), stainless steel stem, and EPDM O-ring stem seals. Provide lever operators with locks for sizes 2 through 6 inches and gear operators with position indicator for sizes 8 through 24 inches. [Provide full lug type body; drilled and tapped valves for dead-end service unless otherwise specified.]

2.6 CHECK VALVES

A. Swing Check Valves, 2-Inch and Smaller: MSS SP-80; Class 125, cast-bronze body and cap conforming to ASTM B 62; with horizontal swing, Y-pattern, and bronze disc; and having threaded or solder ends. Provide valves capable of being reground while the valve remains in the line. Provide Class 150 valves meeting the above specifications, with threaded end connections, where system pressure requires or where Class 125 valves are not available.

B. Swing Check Valves, 2-1/2-Inch and Larger: MSS SP-71; Class 125 (Class 175 FM approved for fire protection piping systems), cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, and bronze disc or cast-iron disc with bronze disc ring; and flanged ends. Provide valves capable of being refitted while the valve remains in the line.

PART 3 - EXECUTION

3.1 VALVE ENDS SELECTION

A. Select valves with the following ends or types of pipe/tube connections:

1. Copper Tube Size, 2-Inch and Smaller: Solder ends, except provide threaded ends for heating hot water and low-pressure steam service. Provide C-MIP adapters for service end valves for copper hot water heating system piping.

2. Steel Pipe Sizes, 2-Inch and Smaller: threaded or grooved end.

3. Steel Pipe Sizes 2-1/2 Inch and Larger: grooved end or flanged.

3.2 VALVE INSTALLATIONS

A. General Application: Use gate, ball, and butterfly valves for shut-off duty; globe, ball, and butterfly for throttling duty. Refer to piping system specification sections for specific valve applications and arrangements.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.

D. Install balance valves in the return piping of all water coils and/or where shown on the drawings.

E. Install three-valve bypass around each pressure reducing valve using throttling-type valves.

F. Install valves in horizontal piping with stem at or above the center of the pipe.

G. Install valves in a position to allow full stem movement.

H. Installation of Check Valves: Install for proper direction of flow as follows:

1. Swing Check Valves: Horizontal position with hinge pin level.

I. Install access doors in ceilings or walls as required in the types and sizes to accommodate easy valve access and construction (sheet rock, etc. and fire rating).

3.3 SOLDER CONNECTIONS

A. Apply heat evenly to outside of valve around joint until solder will melt upon contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

3.4 FLANGED CONNECTIONS

A. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.5 FIELD QUALITY CONTROL

A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.6 ADJUSTING AND CLEANING

A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

3.7 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

VALVES, 2-INCH AND SMALLER				
SERVICE	GATE	GLOBE	BALL	CHECK
Heating Hot Water	150	150	150	150

VALVES, 2-1/2-INCH AND LARGER				
SERVICE	GATE	GLOBE	BUTTERFLY	CHECK
Heating Hot Water	125	125	200	125

3.8 VALVE SCHEDULE

A. Ball Valves - 1 Inch and Smaller:

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Conbraco (Apollo)	70-100	70-200
Milwaukee	BA-100	BA-150
Nibco	T-585-70	S-585-70

B. Ball Valves - 1-1/4 Inch to 2 Inch:

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Conbraco (Apollo)	82-100	82-200
Milwaukee	300S	350S
Nibco	T-590-Y	S-590-Y

1. For grooved end connections, use Victaulic Style 721.
2. For ball valves 2-1/2" and up - flanged carbon steel with stainless steel trim - Milwaukee - F90CS 150R-02 or approved equal.

C. Globe Valves - 2 Inch and Smaller:

MANUFACTURER	CLASS 125 THREADED	CLASS 125 SOLDER	CLASS 150 THREADED
Milwaukee	502	1502	590
Nibco	T-211-B T-211-Y	S-211-B S-211-Y	T-235-Y
Stockham	B16	B14T	B-22

D. Globe Valves - 2-1/2 Inch and Larger:

MANUFACTURER	STRAIGHT BODY	ANGLE BODY
Milwaukee	F2981	F2989
Nibco	F-718-B	F-818-B
Stockham	G-512	G-515

E. Butterfly Valves - 2-1/2 Inch and Larger: Wafer type.

MANUFACTURER	LEVER	GEAR
Milwaukee	CW-223E-B	CW-323E-B
Nibco	WD-20103	WD-20105
Watts	BF-04-111-11	BF-04-111-12

Note: Wafer type valves are to be used only when specifically indicated as approved for use, otherwise use lug type as standard.

1. The following are model numbers for lug-type, with nickel-plated ductile-iron disc:

MANUFACTURER	LEVER	GEAR
Milwaukee	ML-222-E	ML-322-E
Nibco	LD-20103	LD-20105
Watts	BF-03-111-11	BF-03-111-12

2. The following are model numbers for lug-type, with aluminum-bronze disc:

MANUFACTURER	LEVER	GEAR
Milwaukee	ML-223-E	ML-323-E
Nibco	LD-20003	LD-20005
Watts	BF-03-121-11	BF-03-121-12

F. Swing Check Valves - 2 Inch and Smaller:

MANUFACTURER	CLASS 125 THREADED ENDS	CLASS 125 SOLDER ENDS	CLASS 150 THREADED ENDS
Milwaukee	509	1509	510
Nibco	T-413	S-413	T-433
Stockham	B-319	B-309	B-321

G. Swing Check Valves - 2-1/2 Inch and Larger:

MANUFACTURER	CLASS 125	CLASS 175
Milwaukee	F2974	F-2974-FP
Nibco	F-918	X
Stockham	G-931	G-940

1. X means not available.

END OF SECTION 230523

SECTION 230529 SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This section specifies mechanical hangers, support and anchors and includes the following:

1. Horizontal-piping hangers and supports.
2. Vertical-piping clamps.
3. Hanger-rod attachments.
4. Building attachments.
5. Saddles and shields.
6. Spring hangers and supports.
7. Miscellaneous materials.
8. Pipe alignment guides.
9. Anchors.
10. Equipment supports.
11. Roof pipe supports.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5.

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data:

1. Include installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.

C. Shop Drawings: Assembly type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

D. Details: Details of trapeze hangers and upper attachments for piping 4 inches in diameter and over. Include the number and size of pipe lines to be supported on each type of trapeze hanger.

1.4 QUALITY ASSURANCE SUBMITTALS

A. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

1.5 QUALITY ASSURANCE

A. NFPA Compliance: Hangers and supports shall comply with NFPA standard No. 13 when used as a component of a fire protection system.

B. MSS Compliance: Provide hangers, supports and components conforming to the latest requirements of MSS Standard Practices SP-58 and SP-69.

C. Qualify welding processes and welding operators according to AWS D1.1 “Structural Welding Code-Steel.”

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

D. Qualify welding processes and welding operators according to ASME “Boiler and Pressure Vessel Code,” Section IX, “Welding and Brazing Qualifications.”

E. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.

1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.

2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.

1. Components include galvanized coatings where installed for piping and equipment that will not have a field-applied finish.

2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

B. Thermal-Hanger Shield Inserts: 100-psi (690kPa) average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.

C. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

D. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.

2.2 PIPE HANGERS AND SUPPORTS

A. Pipe Insulation Shields: Fabricated of steel, with a minimum of 180 degrees, unless otherwise indicated. Shields for use with hangers and supports, with the exception of combination clevis type hangers, shall be in accordance with the following schedule:

Pipe or Tubing Size (inches)	Shield Length (inches)	Shield Gage
Up to 2	12	18
3 & 4	12	16
6	18	16
8 & up	24	12

B. Pipe Covering Protection Saddles: 3/16 inch thick steel, of sufficient depth for the insulation thickness specified, notched so that saddle contact with the pipe is approximately 50 percent of the total axial cross section. Saddles for pipe 12 inches in size and larger shall have a center support.

C. Pipe Hangers: Height adjustable standard duty clevis type, with cross bolt and nut. Pipe spreaders or spacers shall be used on cross bolts of clevis hangers, when supporting piping 10 inches ips and larger.

D. Adjustable Floor Rests and Base Flanges: Steel.

E. Hanger Rods: Galvanized, mild low carbon steel, fully threaded with two nuts at each end for positioning rod and hanger, and locking each in place.

F. Riser Clamps: Malleable iron or steel.

G. Rollers: Cast Iron.

H. Restraints, Anchors, and Supports for Grooved End Piping System: As recommended by the grooved end fitting manufacturer.

2.3 FASTENERS

A. Sleeve Anchors (Group II, Type 3, Class 3): Molly's Div./USM Corp. Parasleeve Series, Ramset's Dynabolt Series, or Red Head/Phillips AN1405, HN-1614, FS-1411 Series.

B. Wedge Anchors (Zinc Plated, Group II, Type 4, Class 1): Hilti's Kwik Bolt Series, Molly's Div./USM Corp. Parabolt PB Series, Ramset's Trubolt T Series, or Red Head/Phillips WS-3822.

C. Self-Drilling Anchors (Group III, Type 1): Ramset's RD Series, or Red Head/Phillips Series S-14.

D. Non-Drilling Anchors (Group VIII, Type 1): Ramset's Dynaset DS Series, Hilti's HDI Series, or Red Head/Phillips J Series.

E. Stud Anchors (Group VIII, Type 2): Red Head/Phillips JS-38 Series.

F. Continuous Slotted Type Concrete Insert, Galvanized:

1. Load Rating 800 lbs/ft: Kindorf's D-986.
2. Load Rating 1500 lbs/ft: Kindorf's D-980.
3. Load Rating 3000 lbs/ft: Hohmann & Barnard's Inc. Type CS-H.
4. Load Rating 4500 lbs/ft: Hohmann & Barnard's Inc. Type CS-HD.

G. Threaded Type Concrete Insert: Galvanized ferrous castings, internally threaded to receive 3/4 inch dia. machine bolts.

H. Wedge Type Concrete Insert: Galvanized box-type ferrous castings, internally threaded to receive 3/4 inch bolts having special wedge shaped heads.

I. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel; size and type to suit application; galvanized for high humidity locations, and treated wood; plain finish for other interior locations. Except where shown otherwise on the Drawings, furnish type, size, and grade required for proper installation of the Work.

2.4 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.

C. Washers: ASTM F 844, steel, plain, flat washers.

D. Grout: ASTM C 1107, Grade B, nonshrink, nonmetallic.

1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is nonstaining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.

2. Design Mix: 5000-psi (34.5MPa), 28-day compressive strength.

3. Water: Potable.

4. Packaging: Premixed and factory-packaged.

E. Pipe Alignment Guides: Factory fabricated, of cast semisteel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe.

F. Length of guides: As recommended by manufacturer to allow indicated travel.

2.5 EQUIPMENT SUPPORTS

A. 18 gauge galvanized steel; fully welded construction, internally reinforced with integral base plate and factory installed 2 by 4 wood nailer; fully mitered and welded corners; provide 3” cant beginning minimum of 1-1/2” above base plate of assembly and as required to match thickness of deck insulation; base plate pitch so as to maintain flat top; 20 gauge counterflashing.

2.6 ROOF PIPE SUPPORTS

A. Prefabricated Pipe Support System designed for installation without roof penetrations, flashing or damage to the roofing material. The system shall consist of bases, made of high density polypropylene plastics with UV protection, a hot dipped galvanized (HDG) structural steel frame and suitable pipe hangers for the application. Nuts, threaded rods and washers shall be HDG; spring, nuts and bolts for spring nuts shall be electroplated. System shall be custom designed by the manufacturer to fit piping to be installed and the actual conditions of service.

PART 3 - EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69 and SP-89. Arrange for grouping of parallel runs of horizontal

piping supported together on field-fabricated, heavy-duty trapeze hangers where possible. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.

B. Do not hang or support one pipe from another or from ductwork.

C. Support all insulated horizontal piping conveying refrigerants or other fluids below ambient temperature, by means of hangers or supports with insulation shields installed outside of the insulation.

D. Space hangers or supports for horizontal piping on maximum center distances as listed in the following hanger schedules, except as otherwise specified, or noted on the Drawings.

Pipe Material	Maximum Spacing (feet)
Copper Pipe	12
Copper tubing, 1-1/4" and smaller	6
Copper tubing, 1-1/2" and larger	10
CPVC pipe or tubing 1-1/4" and smaller	3
CPVC pipe and tubing 1-1/2" and larger	4
PVC pipe	4
Steel Pipe	12

E. For Steel Pipe Gas Lines: Space hangers or supports on maximum centers of 6 feet for 1/2 inch pipe size; 8 feet for 3/4 inch and 1 inch pipe sizes and 10 feet for 1-1/4 inch pipe size above.

F. For Grooved End Steel Pipe:

Pipe Size (inches)	Maximum Spacing (feet)
1-1/2 and under	7
2 thru 4	10
5 and over	12

No pipe length shall be left unsupported between any two coupling joints.

G. For Directional Changes: Install a hanger or support close to the point of change of direction of all pipe runs in either a horizontal or vertical plane.

H. For Concentrated Loads: Install additional hangers or supports, spaced as required and directed, at locations where concentrated loads such as in-line pumps, valves, fittings or accessories occur, to support the concentrated loads.

I. For Branch Piping Runs and Runouts Over 5 feet in Length: Install a minimum of one hanger, and additional hangers if required by the hanger spacing schedules.

J. Parallel Piping Runs: Where several pipe lines run parallel in the same plane and in close proximity to each other, trapeze hangers may be submitted for approval. Base hanger spacing for trapeze type hangers on the smaller size of pipe being supported. Design the entire hanger assembly based on a safety factor of five, for the ultimate strength of the material being used.

K. Support floor drain traps from the overhead construction, with hangers of type and design as required and approved. Overhead supports are not required for floor drain traps installed directly below earth supported concrete floors.

L. Size hanger rods in accordance with the following:

Pipe or Tubing Size (inches)	Single Rod Hanger Size (inches)		Double Rod Hanger Size (inches)	
	Pipe	Tubing	Pipe	Tubing
Up to 2 inches	3/8	1/4	3/8	1/4
2-1/2 and 3	1/2	3/8	3/8	1/4
4 and 5	5/8	1/2	1/2	3/8
6	3/4	1/2	5/8	1/2
8, 10 and 12	7/8	5/8	3/4	5/8

M. Size hanger rods, for piping over 12 inches in size and multiple line supports, based on a safety factor of five for the ultimate strength of the materials being used.

N. Secure hanger rods as follows: Install one nut under clevis, angle or steel member; one nut on top of clevis, angle or steel member; one nut inside insert or on top of upper hanger attachment and one nut and washer against insert or on lower side of upper hanger attachment. A total of four nuts are required for each road, two at upper hanger attachment and two at hanger.

O. Vertical Piping:

1. Support vertical risers of piping systems, by means of heavy duty hangers installed close to base of pipe risers, and by riser clamps with extension arms at intermediate floors, with the distance between clamps not to exceed 25 feet, unless otherwise specified. Support pipe risers in vertical shafts equivalent to the aforementioned. Install riser clamps above floor slabs, with the extension arms resting on floor slabs. Provide adequate clearances for risers that are subject to appreciable expansion and contraction, caused by operating temperature ranges.

2. Support extension arms of riser clamps, secured to risers to be insulated for cold service, 4 inches above floor slabs, to allow room for insulating and vapor sealing around riser clamps.

3. Install intermediate supports between riser clamps on a maximum 6 foot centers, for copper tubing risers 1-1/4" in size and smaller, installed in finished rooms or spaces other than mechanical equipment machine or steam service rooms, or penthouse mechanical equipment rooms.

4. Floor Supports: Install adjustable yoke rests with base flanges, for the support of piping, unless otherwise indicated on the Drawings. Install supports in a manner, which will not be detrimental to the building structure.

P. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.

Q. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

R. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

S. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so that maximum pipe deflections allowed by ASME B31.9 “Building Services Piping” is not exceeded.

3.2 UPPER HANGER ATTACHMENTS

A. General:

1. In all cases, secure upper hanger attachments to overhead structural steel, steel bar joists, or other suitable structural members.

2. Do not attach hangers to steel decks which are not to receive concrete fill.

3. Do not attach hangers to precast concrete plank decks less than 2-3/4 inches thick.

4. Do not use flat bars or bent rods as upper hanger attachments.

B. Attachment to Steel Frame Construction: Provide intermediate structural steel members where required by pipe support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of five.

1. Do not use drive-on beam clamps.

2. Do not support piping over 4 inches in size from steel bar joists. Secure upper hanger attachments to steel bar joists at panel points of joists.

3. Do not drill holes in main structural steel members.

4. “C” clamp type of upper hanger attachments with restraining straps may be used as upper hanger attachments for the support of piping up to a maximum of 3 inches in size and a temperature from 50°F to 200°F.

C. Attachment to Concrete Filled Steel Deck (Total thickness, 2-1/2 inches or more): Where necessary, attach hangers to the deck with welding studs (except at roof decks), thru-bolts with fish plates or tee hangers. Do not support a load, in excess of 250 lbs from any single welded stud, and thru-bolts with fish plates or tee hangers shall not be used to support piping over 3 inches in size.

D. Attachment to Cored Precast Concrete Decks (Flexicore, Dox Plank, Spancrete, etc): Secure attachments to structural steel wherever possible. When fill is applied over decks, thru-bolts and fish plates may be used to support piping up to a maximum of 4 inches in size; mechanically expanded rod hangers or toggle bolts may be installed in cells for the support of piping up to a maximum of 2-1/2 inches in size.

E. Attachment to Hollow Block or Tile Filled Concrete Decks: Secure hangers to structural steel wherever possible. Inserts may also be used by omitting a block and pouring a solid concrete block, with a cast-in-place insert where required.

F. Attachment to Waffle Type Concrete Decks: Provide cast-in-place inserts where required. When fill is applied over deck, thru-bolts and fish plates may be used.

G. Attachment to Precast Concrete Tee Construction:

1. Secure hangers to tees by any of the following methods:

a. Tee hanger inserts between adjacent flanges.

b. Thru bolts and fish plates, except at roof deck without concrete fill.

c. Dual unit expansion shields in webs of tees. Install shields as high as possible in the webs.

2. Exercise extreme care in the field drilling of holes to avoid damage to reinforcing.

3. Do not use powder driven fasteners.

3.3 TRAPEZES

A. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36 steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

3.4 ANCHORS, RESTRAINTS, RIGID SUPPORTS, STAYS, AND SWAY BRACES

A. Install pipe anchors, restraints, and sway braces, at locations noted on the Drawings. Design anchors so as to permit piping to expand and contract freely in opposite directions, away from anchor points. Install anchors independent of all hangers and supports, and in a manner which will not affect the structural integrity of the building.

B. In grooved end piping systems, install restraints, anchors, and rigid supports as recommended by the manufacturer of the grooved end fittings to ensure proper support and alignment of the piping under operating and testing pressures (maximum hanger or support spacing as previously specified).

1. Horizontal piping: Maintain a constant pitch without sages, humps, or lateral deflections.

2. Branch piping: Install perpendicular to main piping and/or risers.

3. Vertical piping: Install in plumb without deflections.

4. Vertical piping: Support rigidly or anchored at both top and bottom, and wherever necessary to prevent movement and/or shearing forces at branch connections.

3.5 PIPING IN TUNNELS

A. Support piping in tunnels on adjustable stanchions, fabricated in accordance with details on the Drawings, unless otherwise indicated. Install, secure and be responsible for the proper locations of all cast-in-place inserts and stanchion supports in ample time so as not to delay construction work. Secure tops of stanchions to overhead construction, as required and approved.

3.6 COMBINATION CLEVIS HANGER, PIPE INSULATION SHIELD, AND VAPOR BARRIER JACKETED HIGH DENSITY INSULATING SADDLES

A. Install a combination clevis hanger, pipe insulation shield and vapor barrier jacketed high density insulating saddles, at all points of support for piping or tubing to be insulated for cold service. Furnish companion high density vapor barrier jacketed saddle pieces, of the same material, thickness and length, for installation over the top 180 degree surface of pipe or tubing, at each point of support where an insulated clevis hanger is utilized.

3.7 PIPE INSULATION SHIELDS

A. Install a pipe insulation shield, at all points of support, for piping insulated with cold service insulation. Center shields on all hangers and supports, and install in such a manner so as not to cut, puncture or press into the insulation, or in any manner be detrimental to the vapor barrier.

3.8 PIPE COVERING PROTECTION SADDLES

A. Install pipe covering protection saddles at all points of support, for steel piping 6 inches in size and larger, insulated with hot service insulation. Weld saddles to piping to insure movement with pipe.

3.9 INSTALLATION OF ANCHORS

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and with AWS Standards D1.1.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to control movement to compensators.

D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.10 INSTALLATION OF PIPE ALIGNMENT GUIDES

A. Install pipe alignment guides on piping that adjoins expansion joints and elsewhere as indicated.

B. Anchor to building substrate.

3.11 EQUIPMENT SUPPORTS

A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.

B. Grouting: Place grout under supports for piping and equipment.

3.12 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.

B. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces.

1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

C. Ferrous Metals: Clean galvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structure Painting Council.

1. Blast steel surfaces clean as recommended by the paint system manufacturer and in accordance with requirements of SSPC specification SSPC-SP 10.

2. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

3. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by the paint manufacturer, and touch up with the same primer as the shop coat.

D. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum based solvents so that the surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

E. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

F. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

3.13 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

END OF SECTION 230529

SECTION 230548 - MECHANICAL VIBRATION CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes vibration isolators, vibration isolation bases, vibration isolation roof curbs, and seismic restraints and snubbers.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5.

C. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Indicate types, styles, materials, and finishes for each type of isolator specified. Include load deflection curves.

2. Shop Drawings: Show designs and calculations, certified by a professional engineer, for selection of vibration isolators.

1.4 COORDINATION

A. Coordinate layout and installation of vibration isolation and seismic-restraint devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate size and location of concrete housekeeping and vibration isolation bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Sections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-Line Systems, Inc.
2. Mason Industries, Inc.
3. Vibration Eliminator Co., Inc.

2.2 VIBRATION ISOLATORS

A. Isolator Pads: Oil and water resistant and factory cut to sizes that match requirements of the equipment supported.

1. Rubber Isolator Pads: Elastomer (neoprene or silicone) arranged in single or multiple layers and molded with a nonslip pattern and steel baseplates of sufficient stiffness to provide uniform loading over the pad area.

2. Fiberglass or Cork Isolator Pads: Molded cork or glass fiber not less than 1 inch (25 mm) thick and precompressed through 10 compression cycles at 3 times the rated load.

3. Load Range: From 10 to 50 psig (69 to 345 kPa) and a deflection not less than 0.08 inch per 1 inch (2 mm per 25 mm) of thickness. Do not exceed a loading of 50 psig (345 kPa).

B. Rubber Isolator Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements, with encapsulated top- and baseplates. Factory-drilled and tapped top plate for bolted equipment mounting. Factory-drilled baseplate for bolted connection to structure. Color-code to indicate capacity range.

C. Spring Isolators: Freestanding, laterally stable, open-spring-type isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

2. Minimum Additional Travel: 50 percent of the required deflection at rated load.

3. Lateral Stiffness: More than 1.2 times the rated vertical stiffness.

4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Baseplates: Factory drilled for bolting to structure and bonded to a 1/4-inch- (6-mm-) thick, rubber isolator pad attached to the baseplate underside. Size baseplates to limit floor loading to 100 psig (690 kPa).

6. Top Plates: Provide threaded studs for fastening and leveling equipment.

7. Finishes: Manufacturer's standard corrosive-resistant finish.

D. Restrained Spring Isolators: Vertically restrained, freestanding, laterally stable, steel open-spring-type isolators.

1. Housing: Welded steel with resilient vertical limit stops to prevent spring extension due to wind loads or when weight is removed. Factory-drilled baseplate for bolting to structure and bonded to a 1/4-inch- (6-mm-) thick, rubber isolator pad attached to the baseplate underside. Provide adjustable equipment mounting and leveling bolt.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 0.8 times the rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Finishes: Baked enamel for metal components on isolators for interior use. Hot-dip galvanized for metal components on isolators for exterior use.

E. Rubber Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to formed-steel housings with threaded connections for hanger rods. Color-code to indicate capacity range.

F. Spring Hangers: Combination spring and elastomeric hanger with coil spring and elastomeric insert in compression.

1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.

2.3 VIBRATION ISOLATION ROOF CURBS

A. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb designed to resiliently support roof-mounted equipment and to withstand 125-mph (56-m/s) wind impinging laterally against the side of the equipment. Design restraints to meet seismic requirements of authorities having jurisdiction.

B. Components: Upper support frame; lower support assembly; freestanding, unhoused, laterally stable steel springs; vertical and horizontal restraints.

1. Lower Support Assembly: Provide a means of attachment to the building structure and include a wood nailer stripe for attachment of roof material and 2 inches (50 mm) of rigid insulation on the inside of the assembly.

2. Spring Isolators: As indicated or scheduled. Include adjustment bolt to permit leveling of equipment after installation. Attach to lower assembly with a rubber isolation pad. Locate spring isolators so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

3. Water Seal: Elastomeric seal conforming to UL Class A roofing materials, attached to the upper support frame, extending down past the wood nailer of the lower support assembly, and counterflashed over the roof materials.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and anchor vibration-, and sound-, control products according to manufacturer's written instructions and authorities having jurisdiction.

B. Anchor interior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural floors as required by authorities having jurisdiction.

C. Anchor exterior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural supports as required by authorities having jurisdiction.

D. Install flexible pipe connectors at connections for equipment supported on vibration isolators.

3.2 ADJUSTING AND CLEANING

A. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operations.

B. Adjust thrust restraints for a maximum of 1/4 inch (6 mm) of movement at start and stop.

END OF SECTION 230548

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:

1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.

2. Adjusting total HVAC systems to provide indicated quantities.

3. Measuring electrical performance of HVAC equipment.

4. Setting quantitative performance of HVAC equipment.

5. Verifying that automatic control devices are functioning properly.

6. Measuring sound and vibration.

7. Reporting results of the activities and procedures specified in this Section.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-3(l), 16a-38k-4(a)11, 16a-38k-4(b)11.

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed. DEFINITIONS

C. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

D. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.

E. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. Report Forms: Test data sheets for recording test data in logical order.

H. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

I. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

J. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

K. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

L. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

M. Test: A procedure to determine quantitative performance of a system or equipment.

N. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.

O. AABC: Associated Air Balance Council.

P. AMCA: Air Movement and Control Association.

Q. CTI: Cooling Tower Institute.

R. NEBB: National Environmental Balancing Bureau.

S. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.3 QUALITY ASSURANCE SUBMITTALS

A. Within 30 days from the Contractor's Notice to Proceed, submit 2 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.

1.4 INFORMATIONAL SUBMITTALS

A. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3 of this Section.

B. Strategies and Procedures Plan: Within 60 days from the Contractor's Notice to Proceed, submit 2 copies of the testing, adjusting, and balancing strategies and step-by-step procedures as specified in Part 3 "Preparation" Article below. Include a complete set of report forms intended for use on this Project.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

1. Certified Testing, Adjusting, and Balancing Reports: Submit 2 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

1.6 CLOSEOUT SUBMITTALS

A. Warranty: For testing, adjusting, and balancing specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 QUALITY ASSURANCE

A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by either AABC or NEBB.

B. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Engineer's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

a. Submittal distribution requirements.
b. Contract Documents examination report.
c. Testing, adjusting, and balancing plan.
d. Work schedule and Project site access requirements.
e. Coordination and cooperation of trades and subcontractors.
f. Coordination of documentation and communication flow.

C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.

2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.

D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing" or standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

E. Testing, Adjusting, and Balancing Reports: Use standard forms from SMACNA's "HVAC Systems--Testing, Adjusting, and Balancing."

F. Testing, Adjusting, and Balancing Reports: Use testing, adjusting, and balancing Agent's standard forms approved by the Architect.

G. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.

H. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.8 PROJECT CONDITIONS

A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.9 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

B. Notice: Provide 7 days' advance notice for each test. Include scheduled test dates and times.

C. Perform testing, adjusting, and balancing after the required leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.10 WARRANTY

A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Guarantee: Provide a guarantee on AABC'S "National Standards" forms stating that AABC will assist in completing the requirements of the Contract Documents or NEBB will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

1. The certified Agent has tested and balanced systems according to the Contract Documents.

2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.

1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine equipment performance data, including fan and pump curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

E. Examine system and equipment test reports.

F. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

G. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

H. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.

J. Examine strainers for clean screens and proper perforations, and remove temporary screens.

K. Examine 3-way valves for proper installation for their intended function of diverting or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.

N. Examine equipment for installation and for properly operating safety interlocks and controls.

O. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices operate by the intended controller.

2. Dampers and valves are in the position indicated by the controller.

3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.

4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.

5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.

6. Sensors are located to sense only the intended conditions.

7. Sequence of operation for control modes is according to the Contract Documents.

8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.

9. Interlocked systems are operating.

10. Changeover from heating to cooling mode occurs according to design values.

P. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 PREPARATION

A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.

2. Hydronic systems are filled, clean, and free of air.

3. Automatic temperature-control systems are operational.

4. Equipment and duct access doors are securely closed.

5. Balance, smoke, and fire dampers are open.

6. Isolating and balancing valves are open and control valves are operational.

7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

8. Windows and doors can be closed so design conditions for system operations can be met.

3.3 GENERAL TESTING AND BALANCING PROCEDURES

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Cut insulation, ducts, and pipes, for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. For variable-air-volume systems, develop a plan to simulate diversity.

C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

D. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

E. Verify that motor starters are equipped with properly sized thermal protection.

F. Check dampers for proper position to achieve desired airflow path.

G. Check for airflow blockages.

H. Check condensate drains for proper connections and functioning.

I. Check for proper sealing of air-handling unit components.

3.5 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems. Additional procedures are required for other systems. These additional procedures are specified in other articles in this Section.

B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.

b. Measure static pressure directly at the fan outlet, do not measure through the flexible connection.

c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.

d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each air-handling unit component.

a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers under final balanced conditions.

4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures.

5. Adjust fan speed to obtain design cfm. Replace or adjust to pulleys and electrical connections to accommodate fan-speed changes.

6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.

C. Adjust volume dampers for main duct, submain ducts, and major branch ducts to within 10 percent of design airflow.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

a. Where sufficient space in submains and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to within 10 percent of design airflows.

D. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading.

E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.

1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 VARIABLE-AIR-VOLUME SYSTEMS' ADDITIONAL PROCEDURES

A. Compensating for Diversity: When the total airflow of all terminal units is more than the fan design airflow volume, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the design airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.

2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge duct losses.

3. Measure total system airflow. Adjust to within 10 percent of design airflow.

4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use the terminal unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.

5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.

a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.

6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure adequate static pressure is maintained at the most critical unit.

8. Record the final fan performance data.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Balance systems similar to constant-volume air systems.

2. Set terminal units and supply fan at full-airflow condition.

3. Adjust inlet dampers of each terminal unit to design airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.

4. Readjust fan airflow for final maximum readings.

5. Measure operating static pressure at the sensor that controls the supply fan, if one is installed, and verify operation of the static-pressure controller.

6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.

7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.

a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.

8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set system at maximum design airflow by setting the required number of terminal units at minimum airflow. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

2. Adjust supply fan to maximum design airflow with the variable-airflow controller set at maximum airflow.

3. Set terminal units being tested at full-airflow condition.

4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to design airflow. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.

5. Adjust terminal units for minimum airflow.

6. Measure static pressure at the sensor.

7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

3.7 FUNDAMENTAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.

2. Check expansion tank liquid level.

3. Check makeup-water-station pressure gage for adequate pressure for highest vent.

4. Check flow-control valves for specified sequence of operation and set at design flow.

5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type, unless several terminal valves are kept open.

6. Set system controls so automatic valves are wide open to heat exchangers.

7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 HYDRONIC SYSTEMS' BALANCING PROCEDURES

A. Determine water flow at pumps. Use the following procedures, except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Verify with the pump manufacturer that this will not damage pump. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on the manufacturer's pump curve at zero flow and confirm that the pump has the intended impeller size.

2. Check system resistance. With all valves open, read pressure differential across the pump and mark the pump manufacturer's head-capacity curve. Adjust pump discharge valve until design water flow is achieved.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on the pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than design flow.

E. Adjust balancing stations to within specified tolerances of design flow rate as follows:

1. Determine the balancing station with the highest percentage over design flow.

2. Adjust each station in turn, beginning with the station with the highest percentage over design flow and proceeding to the station with the lowest percentage over design flow.

3. Record settings and mark balancing devices.

F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures, including outdoor-air temperature.

G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.9 VARIABLE-FLOW HYDRONIC SYSTEMS' ADDITIONAL PROCEDURES

A. Balance systems with automatic 2- and 3-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS' ADDITIONAL PROCEDURES

A. Balance the primary system crossover flow first, then balance the secondary system.

3.11 MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating of motor.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.12 CONDENSING UNITS

A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

3.13 BOILERS

A. Measure and record entering- and leaving-water temperatures and water flow.

3.14 HEAT-TRANSFER COILS

A. Water Coils: Measure and record the following data for each coil:

1. Entering- and leaving-water temperatures.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperatures of entering and leaving air.
5. Wet-bulb temperatures of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

3.15 TEMPERATURE TESTING

A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure and record indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied. Also measure and record outside air, wet- and dry-bulb temperatures concurrently with above.

3.16 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Verify free travel and proper operation of control devices such as damper and valve operators.

F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.

G. Confirm interaction of electrically operated switch transducers.

H. Confirm interaction of interlock and lockout systems.

I. Verify main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or non-grounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.17 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.18 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of the instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to the certified field report data, include the following:

1. Pump curves.

2. Fan curves.

3. Manufacturers' test data.

4. Field test reports prepared by system and equipment installers.

5. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:

1. Title page.

2. Name and address of testing, adjusting, and balancing Agent.

3. Project name.

4. Project location.

5. Architect's name and address.

6. Engineer's name and address.

7. Contractor's name and address.

8. Report date.

9. Signature of testing, adjusting, and balancing Agent who certifies the report.

10. Summary of contents, including the following:

    a. Design versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

11. Nomenclature sheets for each item of equipment.

12. Data for terminal units, including manufacturer, type size, and fittings.

13. Notes to explain why certain final data in the body of reports vary from design values.

14. Test conditions for fans and pump performance forms, including the following:

    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings, including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:

1. Quantities of outside, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.

F. Rooftop Unit Test Reports: For rooftop units with coils, include the following:

1. Unit Data: Include the following:

    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches (mm), and bore.
    i. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).
    j. Number of belts, make, and size.
    k. Number of filters, type, and size.

2. Motor Data: Include the following:

    a. Make and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.

e. Sheave make, size in inches (mm), and bore.
f. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).

3. Test Data: Include design and actual values for the following:

a. Total airflow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Filter static-pressure differential in inches wg (Pa).
f. Preheat coil static-pressure differential in inches wg (Pa).
g. Cooling coil static-pressure differential in inches wg (Pa).
h. Heating coil static-pressure differential in inches wg (Pa).
i. Outside airflow in cfm (L/s).
j. Return airflow in cfm (L/s).
k. Outside-air damper position.
l. Return-air damper position.
m. Vortex damper position.

G. Apparatus-Coil Test Reports: For apparatus coils, include the following:

1. Coil Data: Include the following:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch (mm o.c.).
f. Make and model number.
g. Face area in sq. ft. (sq. m).
h. Tube size in NPS (DN).
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data: Include design and actual values for the following:

a. Airflow rate in cfm (L/s).
b. Average face velocity in fpm (m/s).
c. Air pressure drop in inches wg (Pa).
d. Outside-air, wet- and dry-bulb temperatures in deg F (deg C).
e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
h. Water flow rate in gpm (L/s).
i. Water pressure differential in feet of head or psig (kPa).
j. Entering-water temperature in deg F (deg C).
k. Leaving-water temperature in deg F (deg C).
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig (kPa).
n. Refrigerant suction temperature in deg F (deg C).

H. Gas -Fired Heat Apparatus Test Reports: In addition to the manufacturer's factory startup equipment reports, include the following:

1. Unit Data: Include the following:

   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Fuel type in input data.
   g. Output capacity in Btuh (kW).
   h. Ignition type.
   i. Burner-control types.
   j. Motor horsepower and rpm.
   k. Motor volts, phase, and hertz.
   l. Motor full-load amperage and service factor.
   m. Sheave make, size in inches (mm), and bore.
   n. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).

2. Test Data: Include design and actual values for the following:

   a. Total airflow rate in cfm (L/s).
   b. Entering-air temperature in deg F (deg C).
   c. Leaving-air temperature in deg F (deg C).
   d. Air temperature differential in deg F (deg C).
   e. Entering-air static pressure in inches wg (Pa).
   f. Leaving-air static pressure in inches wg (Pa).
   g. Air static-pressure differential in inches wg (Pa).
   h. Low-fire fuel input in Btuh (kW).
   i. High-fire fuel input in Btuh (kW).
   j. Manifold pressure in psig (kPa).
   k. High-temperature-limit setting in deg F (deg C).
   l. Operating set point in Btuh (kW).
   m. Motor voltage at each connection.
   n. Motor amperage for each phase.
   o. Heating value of fuel in Btuh (kW).

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data: Include the following:

   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and size.
   e. Manufacturer's serial number.
   f. Arrangement and class.
   g. Sheave make, size in inches (mm), and bore.
   h. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).

2. Motor Data: Include the following:

   a. Make and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.

d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm), and bore.
f. Sheave dimensions, center-to-center and amount of adjustments in inches (mm).
g. Number of belts, make, and size.

3. Test Data: Include design and actual values for the following:

a. Total airflow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Suction static pressure in inches wg (Pa).

J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data: Include the following:

a. System and air-handling unit number.
b. Location and zone.
c. Traverse air temperature in deg F (deg C).
d. Duct static pressure in inches wg (Pa).
e. Duct size in inches (mm).
f. Duct area in sq. ft. ((sq. m)).
g. Design airflow rate in cfm (L/s).
h. Design velocity in fpm (m/s).
i. Actual airflow rate in cfm (L/s).
j. Actual average velocity in fpm (m/s).
k. Barometric pressure in psig (Pa).

K. Air-Terminal-Device Reports: For terminal units, include the following:

1. Unit Data: Include the following:

a. System and air-handling unit identification.
b. Location and zone.
c. Test apparatus used.
d. Area served.
e. Air-terminal-device make.
f. Air-terminal-device number from system diagram.
g. Air-terminal-device type and model number.
h. Air-terminal-device size.
i. Air-terminal-device effective area in sq. ft. ((sq. m)).

2. Test Data: Include design and actual values for the following:

a. Airflow rate in cfm (L/s).
b. Air velocity in fpm (m/s).
c. Preliminary airflow rate as needed in cfm (L/s).
d. Preliminary velocity as needed in fpm (m/s).
e. Final airflow rate in cfm (L/s).
f. Final velocity in fpm (m/s).
g. Space temperature in deg F (deg C).

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data: Include the following:

   a. System and air-handling unit identification.
   b. Location and zone.
   c. Room or riser served.
   d. Coil make and size.
   e. Flowmeter type.

2. Test Data: Include design and actual values for the following:

   a. Airflow rate in cfm (L/s).
   b. Entering-water temperature in deg F (deg C).
   c. Leaving-water temperature in deg F (deg C).
   d. Water pressure drop in feet of head or psig (kPa).
   e. Entering-air temperature in deg F (deg C).
   f. Leaving-air temperature in deg F (deg C).

M. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, include the following:

1. Unit Data: Include the following:

   a. Unit identification.
   b. Location.
   c. Unit make and model number.
   d. Manufacturer's compressor serial numbers.
   e. Compressor make.
   f. Compressor model and serial numbers.
   g. Refrigerant weight in lb (kg).
   h. Low ambient temperature cutoff in deg F (deg C).

2. Test Data: Include design and actual values for the following:

   a. Inlet-duct static pressure in inches wg (Pa).
   b. Outlet-duct static pressure in inches wg (Pa).
   c. Entering-air, dry-bulb temperature in deg F (deg C).
   d. Leaving-air, dry-bulb temperature in deg F (deg C).
   e. Control settings.
   f. Unloader set points.
   g. Low-pressure-cutout set point in psig (kPa).
   h. High-pressure-cutout set point in psig (kPa).
   i. Suction pressure in psig (kPa).
   j. Suction temperature in deg F (deg C).
   k. Condenser refrigerant pressure in psig (kPa).
   l. Condenser refrigerant temperature in deg F (deg C).
   m. Oil pressure in psig (kPa).
   n. Oil temperature in deg F (deg C).
   o. Voltage at each connection.
   p. Amperage for each phase.
   q. The kW input.
   r. Crankcase heater kW.
   s. Number of fans.
   t. Condenser fan rpm.
   u. Condenser fan airflow rate in cfm (L/s).

v. Condenser fan motor make, frame size, rpm, and horsepower.
w. Condenser fan motor voltage at each connection.
x. Condenser fan motor amperage for each phase.

N. Pump Test Reports: For pumps, include the following data. Calculate impeller size by plotting the shutoff head on pump curves.

1. Unit Data: Include the following:

a. Unit identification.
b. Location.
c. Service.
d. Make and size.
e. Model and serial numbers.
f. Water flow rate in gpm (L/s).
g. Water pressure differential in feet of head or psig (kPa).
h. Required net positive suction head in feet of head or psig (kPa).
i. Pump rpm.
j. Impeller diameter in inches (mm).
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data: Include design and actual values for the following:

a. Static head in feet of head or psig (kPa).
b. Pump shutoff pressure in feet of head or psig (kPa).
c. Actual impeller size in inches (mm).
d. Full-open flow rate in gpm (L/s).
e. Full-open pressure in feet of head or psig (kPa).
f. Final discharge pressure in feet of head or psig (kPa).
g. Final suction pressure in feet of head or psig (kPa).
h. Final total pressure in feet of head or psig (kPa).
i. Final water flow rate in gpm (L/s).
j. Voltage at each connection.
k. Amperage for each phase.

O. Boiler Test Reports: For boilers, include the following:

1. Unit Data: Include the following:

a. Unit identification.
b. Location.
c. Service.
d. Make and type.
e. Model and serial numbers.
f. Fuel type and input in Btuh (kW).
g. Number of passes.
h. Ignition type.
i. Burner-control types.
j. Voltage at each connection.
k. Amperage for each phase.

2. Test Data: Include design and actual values for the following:

a. Operating pressure in psig (kPa).
b. Operating temperature in deg F (deg C).
c. Entering-water temperature in deg F (deg C).
d. Leaving-water temperature in deg F (deg C).
e. Number of safety valves and sizes in NPS (DN).
f. Safety valve settings in psig (kPa).
g. High-limit setting in psig (kPa).
h. Operating-control setting.
i. High-fire set point.
j. Low-fire set point.
k. Voltage at each connection.
l. Amperage for each phase.
m. Draft fan voltage at each connection.
n. Draft fan amperage for each phase.
o. Manifold pressure in psig (kPa).

P. Instrument Calibration Reports: For instrument calibration, include the following:

1. Report Data: Include the following:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.19 ADDITIONAL TESTS

A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230700 MECHANICAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes pipe, duct, and equipment insulation.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5.

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 DEFINITIONS

A. Hot Surfaces: Normal operating temperatures of 100ºF or higher.

B. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.

C. Cold Surfaces: Normal operating temperatures less than 75ºF.

D. Thermal Resistivity: "r-values" represent the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees (ºF) between two exposed faces required to cause one Btu to flow through one square foot of material, in one hour, at a given mean temperature.

E. Density: Is expressed in lb/sq.ft.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of mechanical insulation.

1. Include k-value, thickness, and accessories.

C. Schedule: Schedule of materials and thickness for each piece of pipe and equipment.

1.4 INFORMATION SUBMITTALS

A. Manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

A. Fire Performance Characteristics: Conform to the following characteristics for insulation including facings, cements, and adhesives, when tested according to ASTM E 84, by UL or other testing or inspecting organization acceptable to the authority having jurisdiction. Label insulation with appropriate markings of testing laboratory.

1. Interior Insulation: Flame spread rating of 25 or less and a smoke developed rating of 50 or less.

2. Exterior Insulation: Flame spread rating of 75 or less and a smoke developed rating of 150 or less.

1.6 SEQUENCING AND SCHEDULING

A. Schedule insulation application after testing of piping and duct systems.

B. Schedule insulation application after installation and testing of heat trace tape.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Glass Fiber:

a. Knauf Fiberglass GmbH.
b. Manville.
c. Owens-Corning Fiberglas Corporation.

2. Flexible Elastomeric Cellular:

a. Armstrong World Industries, Inc.
b. Halstead Industrial Products.
c. Rubatex Corporation.

3. Vinyl-Acrylic Mastic:

a. Childers Products Co.
b. Knauf Insulation
c. Vimasco Corp.

2.2 GLASS FIBER

A. Material: Inorganic glass fibers, bonded with a thermosetting resin.

B. Jacket: All-purpose, factory-applied, laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil having self-sealing lap.

C. Board: ASTM C 612, Class 2, semi-rigid jacketed board.

1. Thermal Conductivity: 0.25 average maximum, at 75ºF mean temperature.
2. Density: 12 pcf average maximum.

D. Blanket: ASTM C 553, Type II, Class F-1, jacketed flexible blankets.

1. Thermal Conductivity: 0.30 average maximum, at 75ºF mean temperature.

E. Preformed Pipe Insulation: ASTM C 547, Class 1, rigid pipe insulation, jacketed.

1. Thermal Conductivity: 0.27 average maximum at 75ºF mean temperature.
2. Density: 10 average maximum.

F. Adhesive: Produced under the UL Classification and Follow-up service.

1. Type: Non-flammable, solvent-based.
2. Service Temperature Range: Minus 20 to 180ºF.

G. Vapor Barrier Coating: Waterproof coating recommended by insulation manufacturer for outside service.

2.3 FLEXIBLE ELASTOMERIC CELLULAR

A. Material: Flexible expanded closed-cell structure with smooth skin on both sides.

1. Tubular Materials: ASTM C 534, Type I.
2. Sheet Materials: ASTM C 534, Type II.

B. Thermal Conductivity: 0.27 average maximum at 75ºF.

C. Coating: Water based latex enamel coating recommended by insulation manufacturer.

2.4 INSULATING CEMENTS

A. Mineral Fiber: ASTM C 195.

1. Thermal Conductivity: 1.0 average maximum at 500ºF mean temperature.
2. Compressive Strength: 10 psi at 5 percent deformation.

B. Expanded or Exfoliated Vermiculite: ASTM C 196.

1. Thermal Conductivity: 1.10 average maximum at 500ºF mean temperature.
2. Compressive Strength: 5 psi at 5 percent deformation.

C. Mineral Fiber, Hydraulic-Setting Insulating and Finishing Cement: ASTM C 449.

1. Thermal Conductivity: 1.2 average maximum at 400ºF mean temperature.
2. Compressive Strength: 100 psi at 5 percent deformation.

2.5 ADHESIVES

A. Flexible Elastomeric Cellular Insulation Adhesive: Solvent-based, contact adhesive recommended by insulation manufacturer.

B. Lagging Adhesive: MIL-A-3316C, non-flammable adhesive in the following Classes and Grades:

1. Class 1, Grade A for bonding glass cloth and tape to unfaced glass fiber insulation, sealing edges of glass fiber insulation, and bonding lagging cloth to unfaced glass fiber insulation.

2. Class 2, Grade A for bonding glass fiber insulation to metal surfaces.

2.6 JACKETS

A. General: ASTM C 921, Type 1, except as otherwise indicated.

B. Foil and Paper Jacket: Laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

1. Water Vapor Permeance: 0.02 perm maximum, when tested according to ASTM E 96.
2. Puncture Resistance: 50 beach units minimum, when tested according to ASTM D 781.

C. PVC Jacketing: High-impact, ultra-violet-resistant PVC, 20-mils thick, roll stock ready for shop or field cutting and forming to indicated sizes. Color as selected by architect.

1. Adhesive: As recommended by insulation manufacturer.

D. PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil-thick, high-impact, ultra-violet-resistant PVC. Color as selected by architect.

1. Adhesive: As recommended by insulation manufacturer.

2.7 WEATHER RESISTANT JACKET

A. Flexible, self-adhering, weatherproofing system for insulated ductwork. White smooth surface to reflect heat, weather resistant, UV stable, exceeds 25/50 flame/smoke rating, resists vapor transmission, 10 year limited warranty.

1. Flame spread index: ASTM E-84-97a
2. Smoke density index: ASTM-E-84-97a
3. Water vapor transmission: ASTM-E96-95
4. Heat aging: ASTM-D-794
5. Tear strength: ASTM-D1424
6. Tensile strength: ASTM-1000
7. Wind driven rain: South Florida Test 5683

2.8 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth and Tape: Woven glass fiber fabrics, plain weave, presized a minimum of 8 ounces per sq. yd.

1. Tape Width: 4 inches.
2. Cloth Standard: MIL-C-20079H, Type I.
3. Tape Standard: MIL-C-20079H, Type II.

B. Bands: 3/4-inch wide, in one of the following materials compatible with jacket:

1. Stainless Steel: Type 304, 0.020 inch thick.
2. Galvanized Steel: 0.005 inch thick.
3. Aluminum: 0.007 inch thick.
4. Brass: 0.01 inch thick.
5. Nickel-Copper Alloy: 0.005 inch thick.

C. Wire: 14-gage nickel copper alloy, 16-gage, soft-annealed stainless steel, or 16-gage, soft-annealed galvanized steel.

D. Corner Angles: 28-gage, 1-inch by 1-inch aluminum, adhered to 2-inch by 2-inch kraft paper.

E. Anchor Pins: Capable of supporting 20 pounds each. Provide anchor pins and speed washers of sizes and diameters as recommended by the manufacturer for insulation type and thickness.

2.9 SEALING COMPOUNDS

A. Vapor Barrier Compound: Water-based, fire-resistive composition.

1. Water Vapor Permeance: 0.08 perm maximum.
2. Temperature Range: Minus 20 to 180ºF.

B. Weatherproof Sealant: Flexible-elastomer-based, vapor-barrier sealant designed to seal metal joints.

1. Water Vapor Permeance: 0.02 perm maximum.
2. Temperature Range: Minus 50 to 250ºF.
3. Color: Aluminum.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean, dry, and remove foreign materials such as rust, scale, and dirt.

B. Mix insulating cements with clean potable water. Mix insulating cements contacting stainless-steel surfaces with demineralized water.

1. Follow cement manufacturer's printed instructions for mixing and portions.

3.2 INSTALLATION, GENERAL

A. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each mechanical system.

B. Select accessories compatible with materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation or jacket in either the wet or dry state.

C. Install vapor barriers on insulated pipes, ducts, and equipment having surface operating temperatures below 60ºF.

D. Install insulation only after systems to be insulated have been tested and approved.

E. Apply insulation material, accessories, and finishes according to the manufacturer's printed instructions.

F. Install insulation with smooth, straight, and even surfaces.

G. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier.

H. Seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.

I. Seal Ends: Except for flexible elastomeric insulation, taper ends at 45 degree angle and seal with lagging adhesive. Cut ends of flexible elastomeric cellular insulation square and seal with adhesive.

J. Apply adhesives and coatings at manufacturer's recommended coverage-per-gallon rate.

K. Keep insulation materials dry during application and finishing.

L. Install board and block materials with a minimum dimension of 12 inches and a maximum dimension of 48 inches.

M. Items Not Insulated: Unless otherwise indicated do not apply insulation to the following systems, materials, and equipment:

1. Metal ducts with duct liner.

2. Factory-insulated flexible ducts.

3. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.

4. Flexible connectors for ducts and pipes.

5. Vibration control devices.

6. Testing laboratory labels and stamps.

7. Nameplates and data plates.

8. Access panels and doors in air distribution systems.

9. Below grade piping.

10. Piping specialties including air chambers, unions, strainers, check valves, plug valves, and flow regulators.

11. Return air ductwork concealed in spaces which are used as return air plenums need not be insulated, unless otherwise noted.

3.3 PIPE INSULATION INSTALLATION, GENERAL

A. Tightly butt longitudinal seams and end joints. Bond with adhesive.

B. Stagger joints on double layers of insulation.

C. Apply insulation continuously over fittings, valves, and specialties, except as otherwise indicated.

D. Apply insulation with a minimum number of joints.

E. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.

2. Cover circumferential joints with butt strips, at least 3-inches wide, and of same material as insulation jacket. Secure with adhesive along both edges of butt strip and space 4 inches on center.

3. Longitudinal Seams: Overlap seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.

4. Vapor Barrier Coatings: Where vapor barriers are indicated, apply on seams and joints and at ends butt to flanges, unions, valves, and fittings.

5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor barrier coating.

6. Repair damaged insulation jackets, except metal jackets, by applying jacket material around damaged jacket. Adhere and seal. Extend patch at least 2 inches in both directions beyond damaged insulation jacket and around the entire circumference of the pipe.

F. Roof Penetrations: Apply insulation for interior applications to a point even with the top of the roof flashing. Seal with vapor barrier coating. Apply insulation for exterior applications butted tightly to interior insulation ends. Extend metal jacket for exterior insulation outside roof flashing at least 2 inches below top of roof flashing. Seal metal jacket to roof flashing with vapor barrier coating.

G. Exterior Wall Penetrations: For penetrations of below grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor barrier coating.

H. Exterior Wall Penetrations: For penetrations of below grade exterior walls, extend metal jacket for exterior insulation through penetration to a point 2 inches from interior surface of wall inside the building. Seal ends of metal jacket with vapor barrier coating. Secure metal jacket ends with metal band. At point where insulation metal jacket contacts mechanical sleeve seal, insert cellular glass preformed pipe insulation to allow sleeve seal tightening against metal jacket. Tighten and seal sleeve to jacket to form a watertight seal.

I. Interior Walls and Partitions Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions. Apply an aluminum jacket with factory-applied moisture barrier over insulation. Extend 2 inches from both surfaces of wall or partition. Secure aluminum jacket with metal bands at both ends. Seal ends of jacket with vapor barrier coating. Seal around penetration with joint sealer.

J. Fire-Rated Walls and Partitions Penetrations: Terminate insulation at penetrations through fire-rated walls and partitions. Seal insulation ends with vapor barrier coating. Seal around penetration with firestopping or fire-resistant joint sealer.

K. Floor Penetrations: Terminate insulation underside of floor assembly and at floor support at top of floor.

L. Flanges, Fittings, and Valves - Interior Exposed and Concealed: Coat pipe insulation ends with vapor barrier coating. Apply premolded, precut, or field-fabricated segments of insulation around flanges, unions, valves, and fittings. Make joints tight. Bond with adhesive.

1. Use same material and thickness as adjacent pipe insulation.

2. Overlap nesting insulation by 2 inches or 1-pipe diameter, whichever is greater.

3. Apply materials with adhesive, fill voids with mineral fiber insulating cement. Secure with wire or tape.

4. Insulate elbows and tees smaller than 3-inches pipe size with premolded insulation.

5. Insulate elbows and tees 3 inches and larger with premolded insulation or insulation material segments. Use at least 3 segments for each elbow.

6. Cover insulation, except for metal jacketed insulation, with PVC fitting covers and seal circumferential joints with butt strips.

7. Cover insulation, except for metal jacketed insulation, with 2 layers of lagging adhesive to a minimum thickness of 1/16 inch. Install glass cloth between layers. Overlap adjacent insulation by 2 inches in both directions from joint with glass cloth and lagging adhesive.

M. Hangers and Anchors: Apply insulation continuously through hangers and around anchor attachments. For cold surface piping, extend insulation anchor legs a minimum of 12 inches and taper and seal insulation ends.

1. Inserts and Shields: Cover hanger inserts and shields with jacket material matching adjacent pipe insulation.

2. Special Treatment at Hanger Locations: At hanger locations on insulated piping 2” and larger, install high density rigid fiber glass pipe support blocks. On piping up to and including 5”, install one block at each hanger, directly on the bottom of the pipe. For 6”, 8”, and 10” piping, install two (2) blocks at each hanger oriented 30 degrees from each side of the bottom. For piping 12” and larger, orientate blocks at both the 30 degrees positions and directly on the bottom. Install blocks inside cut out section of pipe insulation, being careful not to damage the vapor barrier jacketing. Any jacketing so damaged should be repaired with matching vapor barrier tape.

3.4 BELOW GROUND PIPE INSULATION INSTALLATION

A. General: The following are additional requirements for insulation applied to piping installed below ground.

B. Coat bore surfaces of insulation materials with insulating cement of type recommended by insulation manufacturer. Apply enough cement to fill surface cells. Do not use adhesives for this coating.

C. Secure insulation with a minimum of 2 stainless-steel bands for each section of insulation.

D. Terminate insulation at anchor blocks.

E. Apply insulation continuously through sleeves and manholes, except as specified above for exterior wall penetrations.

F. Finishing: Apply 3 coats of asphaltic mastic to a finish thickness of 3/16 inch over insulation materials. Apply 10 x 10 mesh glass cloth between coats. Overlap edges of glass cloth by 2 inches.

3.5 GLASS FIBER PIPE INSULATION INSTALLATION

A. Bond insulation to pipe with lagging adhesive.

B. Seal exposed ends with lagging adhesive.

C. Seal seams and joints with vapor barrier compound.

3.6 FLEXIBLE ELASTOMERIC CELLULAR PIPE INSULATION INSTALLATION

A. Slip insulation on the pipe before making connections wherever possible. Seal joints with adhesive. Where the slip-on technique is not possible, cut one side longitudinally and apply to the pipe. Seal seams and joints with adhesive.

B. Valves, Fittings, and Flanges: Cut insulation segments from pipe or sheet insulation. Bond to valve, fitting, and flange and seal joints with adhesive.

1. Miter cut materials to cover soldered elbows and tees.

2. Fabricate sleeve fitting covers from flexible elastomeric cellular insulation for screwed valves, fittings, and specialties. Miter cut materials. Overlap adjoining pipe insulation.

3.7 GLASS FIBER EQUIPMENT INSULATION INSTALLATION

A. Secure insulation with anchor pins and speed washers.

B. Space anchors at maximum intervals of 18 inches in both directions and not more than 3 inches from edges and joints.

C. Apply a smoothing coat of insulating and finishing cement to finished insulation.

3.8 FLEXIBLE ELASTOMERIC CELLULAR EQUIPMENT INSULATION INSTALLATION

A. Install sheets of the largest manageable size.

B. Apply full coverage of adhesive to the surfaces of the equipment and to the insulation.

C. Butt insulation joints firmly together and apply adhesive to insulation edges at joints.

3.9 DUCT INSULATION

A. Install block and board insulation as follows:

1. Adhesive and Band Attachment: Secure block and board insulation tight and smooth with at least 50 percent coverage of adhesive. Install bands spaced 12 inches apart. Protect insulation under bands and at exterior corners with metal corner angles. Fill joints, seams, and chipped edges with vapor barrier compound.

2. Speed Washers Attachment: Secure insulation tight and smooth with speed washers and welded pins. Space anchor pins 18 inches apart each way and 3 inches from insulation joints. Apply vapor barrier coating compound to insulation in contact, open joints, breaks, punctures, and voids in insulation.

B. Blanket Insulation: Install tight and smooth. Secure to ducts having long sides or diameters as follows:

1. Smaller than 24 Inches: Bonding adhesive applied in 6-inch-wide transverse strips on 12-inch centers.

2. 24 Inches and Larger: Anchor pins spaced 12 inches apart each way. Apply bonding adhesive to prevent sagging of the insulation.

3. Overlap joints 3 inches.

4. Seal joints, breaks, and punctures with vapor barrier compound.

5. Minimize compression during installation.

3.10 JACKETS

A. Foil and Paper Jackets (FP): Install jackets drawn tight. Install lap or butt strips at joints with material same as jacket. Secure with adhesive. Install jackets with 1-1/2-inch laps at longitudinal joints and 3-inch-wide butt strips at end joints.

1. Seal openings, punctures, and breaks in vapor barrier jackets and exposed insulation with vapor barrier compound.

2. Provide PVC fitting covers.

B. Interior Exposed Insulation: Install continuous PVC jackets.

C. Install the PVC jacket with 1-inch overlap at longitudinal and butt joints and seal with adhesive.

D. Install glass cloth jacket directly over insulation. On insulation with a factory applied jacket, install the glass cloth jacket over the factory applied jacket. Install jacket drawn smooth and tight with a 2-inch overlap at joints. Embed glass cloth between (2) 1/16-inch-thick coats of lagging adhesive. Completely encapsulate the insulation with the jacket, leaving no exposed raw insulation.

E. Special Protection for Ductwork Exposed to the Weather:

1. Rectangular: Weatherproof with a durable asbestos-free water based vinyl-acrylic mastic, applied in two (2) coats. Apply the first tack coat at a rate of two (2) gallons per 100 sq. ft. While still wet, lay an open weave glass cloth membrane and embed with all fabric seams overlapped 2" minimum. Apply a finish coat at a coverage of four (4) gallons per 100 sq. ft., fully covering the cloth membrane, so that the minimum dry film thickness is 1/16". Trowel, spray, or wet brush to a smooth, even finish. Install the insulation on the top of the ductwork with a positive pitch to drain off all water and prevent ponding on the top surfaces.

2. Round: Weatherproof with a high impact, UV resistant polyvinyl chloride jacketing, 20 mil. thickness minimum. Cut to the proper size from roll stock, including a 3" – 4" overlap for both longitudinal and circumferential joints. Install over duct insulation, avoiding "fishmouths," and secure longitudinal overlap with either outward clinching staples or stainless steel tack fasteners. Tape all joints with matching PVC tape. Position all longitudinal overlaps at either the 4:30 or 7:30 position to shed water. Secure jacketing with aluminum banding on 24" centers.

3. Weatherproof outdoor ductwork ONLY when the outdoor temperature is 40°F or greater.

3.11 FINISHES

A. Flexible Elastomeric Cellular Insulation: After adhesive has fully cured, apply 2 coats of protective coating to exposed insulation.

3.12 APPLICATIONS

A. General: Materials and thicknesses are specified in schedules at the end of this Section.

B. Interior Piping Systems: Unless otherwise indicated, insulate the following piping systems:

1. Refrigerant
2. Heating hot water.
3. Cooling coil condensate.

C. Exterior Piping Systems: Unless otherwise indicated, insulate the following piping systems:

1. Refrigerant.

D. Equipment: Unless otherwise indicated, insulate the following indoor equipment:

1. Heating hot water expansion tanks and air separator.Boiler flues and breechings.

E. Duct Systems: Unless otherwise indicated, insulate the following duct systems:

1. Interior supply, return and outside air ductwork.
2. Exterior exposed supply and return ductwork.
3. Interior exposed and concealed outside and exhaust air plenums.

3.13 PIPE INSULATION SCHEDULES

A. General: Abbreviations used in the following schedules include:

1. Field-Applied Jackets: P - PVC, K - Foil and Paper, A-Aluminum, SS - Stainless Steel.
2. Pipe Sizes: NPS - Nominal Pipe Size.

B. Domestic Cold Water, Cooling Coil Condensate, and Storm Water All Sizes (Interior): 1/2-inch-thick glass fiber insulation with vapor barrier. Field-applied jacket is not required.

INTERIOR REFRIGERANT

Pipe Sizes (NPS)	**Materials**	**Thickness in Inches**	**Vapor Barrier Required**	**Field-Applied Jacket**
1-1/2 or less	Flexible Elastomeric	1	Yes	None

EXTERIOR REFRIGERANT

Pipe Sizes (NPS)	**Materials**	**Thickness in Inches**	**Vapor Barrier Required**	**Field-Applied Jacket**
1-1/2 or less	Flexible Elastomeric	1	Yes	(P) (A) (SS)

INTERIOR HEATING HOT WATER

Pipe Sizes (NPS)	**Materials**	**Thickness in Inches**	**Vapor Barrier Required**	**Field-Applied Jacket**
1-1/2 or less	Glass Fiber	1	No	(P) Exposed (color by architect), otherwise None
2 or greater	Glass Fiber	2	No	(P) Exposed (color by architect), otherwise None

EXTERIOR RTU-1 THRU 10 HEAT TRACED CONDENSATE AND P-TRAP

Pipe Sizes (NPS)	**Materials**	**Thickness in Inches**	**Vapor Barrier Required**	**Field-Applied Jacket**
All	Glass Fiber	2	No	Weather Resistant (white)

3.14 DUCT SYSTEMS INSULATION SCHEDULE

A. General: Abbreviations used in the following schedules include:

1. Field-Applied Jackets: P - PVC, K - Foil and Paper, A-Aluminum, SS - Stainless Steel.

INTERIOR CONCEALED HVAC SUPPLY, RETURN AND OUTSIDE AIR DUCTS AND PLENUMS

Material	**Form**	**Thickness in Inches**	**Vapor Barrier Required**	**Field-Applied Jacket**
Glass Fiber	Blanket	1-1/2	Yes	None

INTERIOR EXPOSED HVAC SUPPLY, RETURN AND OUTSIDE AIR DUCTS AND PLENUMS

Material	**Form**	**Thickness in Inches**	**Vapor Barrier Required**	**Field-Applied Jacket**
Glass Fiber	Board - Rect.	1-1/2	Yes	None

EXTERIOR EXPOSED HVAC SUPPLY AND RETURN DUCTS AND PLENUMS

Material	**Form**	**Thickness in Inches**	**Vapor Barrier Required**	**Field-Applied Jacket**
Glass Fiber	Board - Rect.	2	Yes	Weather Resistant (white)

END OF SECTION 230700

SECTION 230800 –COMMISSIONING OF HVAC

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Notice to Contractor Sections, apply to this Section. Refer to NOTICE TO CONTRACTOR – COMMISSIONING for a full description of the commissioning process and requirements.

1.2. SUMMARY

A. Commissioning consists of systematically documenting that specified components and systems have been installed and started up properly and then functionally tested to verify and document proper operation through all sequences of operation and conditions. In addition, training of the Owner's Operations Personnel will be verified and final project O&M Documents will be reviewed for completeness.

PART 2 – PRODUCTS

2.1. FUNCTIONAL PERFORMANCE TESTING EQUIPMENT AND INSTRUMENTS

A. Contractor shall provide all tools, instruments, laptop computers, PDA's, software programs and services required to perform system Functional Performance Testing procedures. This includes providing the connection to systems to be tested, operation of the test equipment & instrumentation and generating test results as required.

PART 3 – EXECUTION

3.1. FUNCTIONAL PERFORMANCE TESTING

A. The contractor shall demonstrate to the Engineer and the Cx Authority the performance of the following HVAC Systems to the performance level identified.

1. Heating Water Distribution System:

a. System/Equipment to be Tested:

1) Boilers
2) Pumps and associated VFDs
3) Glycol makeup package
4) Safety Devices
5) All Associated Control Devices

b. Functions to be Tested:
    1) Setpoint control and boiler staging
    2) Pump lead / lag operation
    3) Variable HW flow control
    4) Makeup water/glycol control
    5) Alarm functions & reporting

c. Conditions of the Test:
    1) System operation at 25%, 50%, 75%, and 100% load conditions
    2) System operation under emergency power condition
    3) Operation in unoccupied mode

d. Acceptance Criteria:
    1) All control loops provide stable control within ± 2°F of setpoint
    2) All alarm conditions shall report within 3 seconds

2. Air Handling Units:

a. System/Equipment to be Tested:
    1) Fans and associated VFDs
    2) Heating coil
    3) Cooling coil
    4) Dampers
    5) Economizer
    6) Safety devices
    7) All associated control devices

b. Functions to be Tested:
    1) Discharge air temperature control
    2) Minimum ventilation control
    3) Airflow control
    4) Alarm functions & reporting

c. Conditions of the Test:
    1) System operation at summer and winter load conditions
    2) System operation under emergency power conditions
    3) Operation in unoccupied mode
    4) Operation under fire alarm condition

d. Acceptance Criteria:
    1) Temp control loops shall provide stable control within +/- 2° F of setpoint
    2) Airflow control loops shall provide stable control within +/- 1.0”wc or +/- 250 CFM of setpoint
    3) All alarm conditions shall report within 3 seconds

3. Energy Recovery Ventilators:

a. System/Equipment to be Tested:
    1) Direct fired gas furnaces
    2) Supply and Exhaust Fans
    3) Energy wheel
    4) Control Dampers
    5) All associated control and safety devices

b. Functions to be Tested:
    1) Discharge air temperature control
    2) Energy recovery
    3) Airflow control
    4) Alarm functions and reporting

c. Conditions of the Test:
    1) System operation at summer and winter load conditions
    2) System operation under emergency power conditions
    3) Operation in unoccupied mode
    4) Operation under fire alarm condition

d. Acceptance Criteria:
    1) Temp control loops shall provide stable control within +/- 2° F of setpoint
    2) Airflow control loops shall provide stable control within +/- 1.0”wc or +/- 250 CFM of setpoint
    3) All alarm conditions shall report within 3 seconds

4. Make-Up Air Unit:

a. System/Equipment to be Tested:
    1) Supply Fan
    2) Indirect fired gas furnace
    3) Control Dampers
    4) All associated control and safety devices

b. Functions to be Tested:
    1) Discharge air temperature control
    2) Interface with exhaust fan EF-13
    3) Airflow control
    4) Alarm functions & reporting

c. Conditions of the Test:
    1) System operation at summer and winter load conditions
    2) System operation under emergency power conditions
    3) Operation in unoccupied mode
    4) Operation under fire alarm condition

d. Acceptance Criteria:
    1) Temp control loops shall provide stable control within +/- 2° F of setpoint
    2) Airflow control loops shall provide stable control within +/- 1.0”wc or +/- 250 CFM of setpoint
    3) All alarm conditions shall report within 3 seconds

5. Exhaust Fans:

a. System/Equipment to be Tested:
    1) Exhaust fans / motors and all associated controls
    2) A random selection of 25% of the units shall be tested. Failure 10% of the randomly selected units in the first set shall require an additional equally selected quantity to be tested. Failure of 10% of the second set shall result in all remaining exhaust fans to be tested.

b. Functions to be Tested:

1) Airflow setpoint control
2) Fan staging
3) Smoke evacuation control
4) Alarm functions & reporting.

c. Conditions of the Test:
1) System operation under normal & emergency power conditions
2) System operation in fire alarm condition
3) Operation in unoccupied mode

d. Acceptance Criteria:
1) Temp control loops shall provide stable control within +/- 2° F of setpoint
2) Airflow control loops shall provide stable control within +/- 10% of CFM setpoint
3) All alarm conditions shall report within 3 seconds

6. Fan Powered VAV Terminal Units:

a. System/Equipment to be Tested:
1) Fan Powered Terminal Units and all associated controls
2) A random selection of 25% of the units shall be tested. Failure of 10% of the randomly selected units in the first set shall require an additional equally selected quantity to be tested. Failure of 10% of the second set shall result in all remaining terminal units to be tested.

b. Functions to be Tested:
1) Space temp setpoint control
2) Fan / damper / coil sequencing
3) Air flow setpoint control
4) Alarm functions and reporting

c. Conditions of the Test:
1) Zone control in heating and cooling modes
2) Operation in unoccupied mode

d. Acceptance Criteria:
1) Control loop provides stable control and maintains space conditions within +/- 1° F
2) Airflow control loop provides stable control and maintains airflow within 10% of setpoint
3) Alarm conditions shall report within 10 seconds

7. Non Fan Powered VAV Terminal Units:

a. System/Equipment to be Tested:
1) Fan Powered Terminal Units and all associated controls
2) A random selection of 25% of the units shall be tested. Failure of 10% of the randomly selected units in the first set shall require an additional equally selected quantity to be tested. Failure of 10% of the second set shall result in all remaining terminal units to be tested.

b. Functions to be Tested:
1) Space temp setpoint control
2) Damper / coil sequencing

3) Air flow setpoint control
4) Alarm functions and reporting

c. Conditions of the Test:
1) Zone control in heating and cooling modes
2) Operation in unoccupied mode

d. Acceptance Criteria:
1) Control loop provides stable control and maintains space conditions within +/- 1° F
2) Airflow control loop provides stable control and maintains airflow within 10% of setpoint
3) Alarm conditions shall report within 10 seconds

8. Unit Heaters:

a. System/Equipment to be Tested:
1) Unit Heaters
2) Cabinet Unit Heaters
3) Electric heaters
4) All associated control devices
5) A random selection of 25% of the units shall be tested. Failure of 10% of the randomly selected units in the first set shall require an additional equally selected quantity to be tested. Failure of 10% of the second set shall result in all remaining units to be tested.

b. Functions to be Tested:
1) Space temp setpoint control
2) Alarm functions & reporting.

c. Conditions of the Test:
1) Zone control at 50% and 100% load conditions
2) Operation in unoccupied mode.

d. Acceptance Criteria:
1) Control loop provides stable control and maintains space conditions within +/- 2° F

9. Finned Tube Radiators:

a. System/Equipment to be Tested:
1) Finned Tube Radiators and all associated control devices
2) A random selection of 25% of the units shall be tested. Failure of 10% of the randomly selected units in the first set shall require an additional equally selected quantity to be tested. Failure of 10% of the second set shall result in all remaining units to be tested.

b. Functions to be Tested:
1) Space temp setpoint control
2) Alarm functions & reporting

c. Conditions of the Test:
1) Zone control at 50% and 100% load conditions
2) Operation in unoccupied mode

d. Acceptance Criteria:
    1) Control loop provides stable control and maintains space conditions within +/- 2° F

10. Fan Coil Units:

a. System/Equipment to be Tested:
    1) Fan Coil Units and all associated control devices
    2) A random selection of 25% of the units shall be tested. Failure of 10% of the randomly selected units in the first set shall require an additional equally selected quantity to be tested. Failure of 10% of the second set shall result in all remaining units to be tested.

b. Functions to be Tested:
    1) Space temp setpoint control
    2) Damper / coil sequencing
    3) Alarm functions and reporting

c. Conditions of the Test:
    1) Zone control at 50% and 100% load conditions
    2) Operation in unoccupied mode

d. Acceptance Criteria:
    1) Control loop provides stable control and maintains space conditions within +/- 2° F

11. Ductless Split System Air Conditioners:

a. System/Equipment to be Tested:
    1) Package indoor unit
    2) Remote condensing unit
    3) Interconnecting piping
    4) Safety devices
    5) All associated control devices
    6) A random selection of 25% of the units shall be tested. Failure of 10% of the randomly selected units in the first set shall require an additional equally selected quantity to be tested. Failure of 10% of the second set shall result in all remaining units to be tested.

b. Functions to be Tested:
    1) Space temp control
    2) Alarm functions & reporting.

c. Conditions of the Test:
    1) System operation at 25%, 50%, 75% and 100% load conditions
    2) System operation in unoccupied mode

d. Acceptance Criteria:
    1) Temp control loops shall provide stable control within +/- 2° F of setpoint
    2) All alarm conditions shall report within 3 seconds

12. Building Automation System:

a. System/Equipment to be Tested:

1) Operator workstations
2) Peripheral devices
3) Communications cabling

b. Functions to be Tested:
1) All features of the front end software, including but not limited to, graphical displays, setpoint & related parameter control, alarm reporting, time of day scheduling, data trending, etc.

c. Conditions of the Test:
1) System shall be complete and fully operational
2) Operation will be tested under normal and emergency power conditions

d. Acceptance Criteria:
1) Graphics shall be clear and uncluttered
2) All system software and applications shall be the current revision available

3.2. SEASONAL TESTING

A. Certain weather conditions and load conditions are required to complete some functional testing and verification activities. Such deferred performance verification will be conducted at an appropriate time, and under appropriate conditions, as early as possible after occupancy. The same requirements described for Functional Performance Testing in this section will apply to Seasonal Testing.

END OF SECTION 230800

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for HVAC equipment that are not supplied with factory-wired controls.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-3(l), 16a-38k-4(a)11, 16a-38k-4(b)11.

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 SYSTEM DESCRIPTION

A. Provide a microprocessor based direct digital control (DDC) building automation system (BAS) as a complete system suitable for the control of the heating, ventilating and air conditioning (HVAC) and other building-level systems as specified and shown. The system shall include software with all necessary means for global data exchange, scheduling, local and remote control and adjustment; load shedding for demand controls; even management; monitoring; trending; logging; maintenance notification; and alarms.

B. Building operators workstation for this project shall be located in Room A110. Coordinate the final location with the facility.

C. All utility meters including domestic water meter, natural gas meter, and electric meter shall have remote meter readings through the BAS. Utility meters shall be provided by the utility companies.

D. The control system shall be complete in all respects with system completeness (turnkey system) for the building automation system (BAS). System shall be a BACnet direct digital control system. The control system shall consist of a high-speed, peer-to-peer network of DDC controllers and a web-based operator interface. Depict each mechanical system and building floor plan by a point-and-click graphic. A web server with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. Control system consists of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, wiring, and accessories connected to controllers to operate mechanical systems according to sequences of operation indicated or specified. Provide all hardware, software and ancillary components, and wiring not specifically indicated or specified, but necessary to make the system function according to the intent of the specification. The control system contractor shall also be responsible for the proper operation of the control system and shall provide all necessary debugging and calibration. Size all control apparatus to properly supply and/or operate and control the apparatus served. Note that the control specifications in the design documents may be generic or have a limited amount interfacing information or job specifics (to varying degrees). Examine not only the plans and specifications for this Specification Section, but plans and specifications of other related sections and visit the site to become acquainted with all project conditions including existing conditions. Execution of Contract is evidence that control system contractor has examined all drawings and specifications, and that all conditions of installing the work in this Section are verified. Later claims for labor and materials required due to difficulties

encountered, which could have been foreseen had examination been made, will not be recognized. The control system shall fully integrate all distributed digital controls, energy management controls and interfaces to mechanical equipment specified elsewhere in Division 23. The DDC panels shall be located in new electric room on the second floor as indicated on the drawing. The new BACnet DDC system shall have been totally programmed and verified as satisfying the requirements of the Sequence of Operation contained hereinafter. However, it shall be possible to reprogram the panels on site either by the BAS Contractor or the Owner. The new DDC system shall be configured to perform all control, alarming, scheduling and energy management routines either as a distributed processing unit to a central remote monitoring and control system or as a standalone unit. The DDC system shall have capability to allow for remote monitoring, controls and reprogramming by system operators through the existing BAS systems. Additional capabilities shall include all physical points be automatically trended and alarmed, gathering reports and logs, programming and downloading databases.

E. The controls contractor shall provide data storage equipment with off-site backup storage and uninterruptable power supply for the purpose of trending all data associated with the requirements of Measurement and Verification. Provide sufficient storage capacity to hold data retrieved every 15 minutes for aperiod of one year.

F. Upon completion of project ALL host software, documentation, databases, application programming tools, graphical creation tools, passwords shall become owner's property

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include manufacturer's technical Product Data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, installation instructions, and startup instructions.

C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection. Submit damper leakage and flow characteristics, plus size schedule for controlled dampers.

D. Shop Drawings containing the following information for each control system:

1. Schematic flow diagram showing fans, pumps, coils, dampers, valves, and control devices.

2. Each control device labeled with setting or adjustable range of control.

3. Diagrams for all required electrical wiring. Clearly differentiate between factory-installed and field-installed wiring.

4. Details of control panel faces, including controls, instruments, and labeling.

5. Written description of sequence of operation.

6. Trunk cable schematic showing programmable control unit locations and trunk data conductors.

7. Listing of connected data points, including connected control unit and input device.

8. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.

9. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.

10. Software description and sequence of operation.

E. Wiring diagrams detailing wiring for power, signal, and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.

1.4 QUALITY ASSURANCE SUBMITTALS

A. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of control systems equipment to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1. Maintenance instructions and spare parts lists for each type of control device and compressed-air stations.

2. Interconnection wiring diagrams with identified and numbered system components and devices.

3. Keyboard illustrations and step-by-step procedures indexed for each operator function.

4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

5. Calibration records and list of set points.

B. Warranty: For each type of control systems equipment specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer specializing in control system installations.

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing control systems similar to those indicated for this Project and that have a record of successful in-service performance.

C. Startup Personnel Qualifications: Engage specially trained personnel in direct employ of manufacturer of primary temperature control system.

D. Comply with NFPA 90A.

E. Comply with NFPA 70.

F. Coordinate equipment selection with Division 26 Section to achieve compatibility with equipment that interfaces with that system.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store equipment and materials inside and protected from weather.

B. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.

1.8 MAINTENANCE

A. Extra Materials: Furnish to Owner, a quantity of 10% of each types and size of current transmitter and space temperature sensors and space thermostats.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

1. Direct Digital Control (DDC) Systems and Components:

a. Alerton Technologies, Inc.
b. Automated Logic Corporation.
c. Andover Controls

2.2 DIRECT DIGITAL CONTROL (DDC) EQUIPMENT

A. Application Software: Include the following:

1. Input/output capability from operator station.
2. Operator system access levels via software password.
3. Database creation and support.
4. Dynamic color graphic displays.
5. Alarm processing.
6. Event processing.
7. Automatic restart of field equipment on restoration of power.
8. Data collection.
9. Graphic development on workstation.
10. Maintenance management.

B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and back-up power source.

1. Units monitor or control each input/output point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator station.

2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

a. Global communications.

b. Discrete/digital, analog, and pulse input/output.

c. Monitoring, controlling, or addressing data points.

d. Testing and developing control algorithms without disrupting field hardware and controlled environment.

C. Local Area Networks (LANs): Not less than 60 stations or nodes at minimum 19.2 kB.

1. System Support: Capacity for a minimum of 10 workstations connected to multiuser, multitasking environment with concurrent capability to access DDC network or control units.

D. Software: Update to latest version of software at project completion. Include and implement the following capabilities from the control units:

1. Units of Measure: Inch-pound and SI metric.

2. Load Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, DDC with fine tuning, and trend logging.

3. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.

4. Programming Application Features: Include trend point, alarm messages, weekly scheduling, and interlocking.

2.3 COMMUNICATION

A. Control products, communication media, connectors, repeaters, hubs, and routers shall comprise a BACnet internetwork. Controller and operator interface communication shall conform to ANSI/ASHRAE Standard 135-2004, BACnet. LON is not an acceptable protocol.

B. The Building Automation System (BAS) shall consist of a two-tiered system of an upper level Ethernet TCP/IP Network, and a twisted-pair field bus of Standalone Digital Control Units (SDCUs). All field bus communications must be routed through Ethernet based network controllers or routers, and not directly through PC workstations or servers.

C. The owner shall provide a minimum of one Ethernet network drop and internet access with static IP address to allow communication with the BAS System for remote configuration, diagnostics and service by the BAS supplier.

D. Level 1 Controllers, the main backbone of the system, shall be an Ethernet 10/100bT LAN/WAN. Network Router/Controllers, Operator Workstations, and the Central File Server shall connect directly to this network without the need for Gateway devices.

E. Where required, provide a BACnet gateway to interface to non-BACnet systems that use the Modbus RTU protocol or other proprietary protocol. The gateway shall communicate directly over Ethernet TCP/IP and shall use the BACnet/IP protocol to communicate with the operators workstation.

F. Level 2 Controllers of the system shall consist of one MS/TP field buses managed by the Network Router/Controllers. Minimum speed shall be 76.8kbps. The Level 2 field bus consists of an RS485, token passing bus that supports up to 127 Standalone Digital Control Units (SDCUs).

2.4 CONTROL PANELS

A. Central (Master) Control Panels: Fully enclosed, steel-rack-type cabinet with locking doors or locking removable backs. Match finish of panels and provide multicolor graphic displays, schematically showing system being controlled.

B. Local Control Panels: Unitized cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.

1. Fabricate panels of 0.06-inch- (1.5-mm-) thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock, with manufacturer's standard shop-painted finish and color.

2. Panel-Mounted Equipment: Temperature and humidity controllers, relays, and automatic switches; except safety devices. Mount devices with adjustments accessible through front of panel.

3. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, changeover switches, thermometers, and gages.

4. Graphics: Color-coded graphic, laminated-plastic displays on doors, schematically showing system being controlled, with protective, clear plastic sheet bonded to entire door.

5. Panels located within Chassis Wash M103 and Bus Wash S112 shall be NEMA 4 type.

C. STANDALONE DIGITAL CONTROL UNITS (SDCU)

1. Standalone Digital Control Units shall provide control of HVAC, including air handling units, rooftop units, variable air volume boxes, and other mechanical equipment. Each controller shall be fully programmable, contain its own control programs and will continue to operate in the event of a failure or communication loss to its associated network controller.

2. Both the operating system of the controller, plus the application program for the controller, shall be stored in non-volatile, FLASH memory. Controllers shall contain enough memory for the current application, plus required history logging, plus a minimum of 20% additional free memory.

3. SDCUs shall have a RS-485 communication port to the MS/TP field bus, operating at a speed of at least 76.8kbps.

a. Input/Output

Each SDCU shall have enough inputs and outputs to meet the application's required points. Each SDCU shall support universal inputs, whereas any input may be software-defined as:

1.) Digital Inputs for status/alarm contacts.
2.) Counter Inputs for summing pulses from meters.
3.) Thermistor Inputs for measuring temperatures in space, ducts and thermowells.
4.) Analog inputs for pressure, humidity, flow and position measurements.

b. SDCU's must support both digital and analog output types:

1.) Digital Outputs for on/off equipment control.
2.) Analog Outputs for valve and damper position control, and capacity control of primary equipment.

4. Expandability:

5. For larger controllers (16 base inputs and up), provide input and output expansion through the use of plug-in modules. At least two I/O modules must be capable of being added to the base SDCU.

6. Hardware Override Switches:

a. All digital outputs on air handling unit controllers shall include three position manual override switches to allow selection of the ON, OFF, or AUTO output state. These switches shall be built into the unit and shall provide feedback to the controller so that the position of the override switch can be obtained through software. In addition each analog output on air handling unit controllers shall be equipped with an override potentiometer to allow manual adjustment of the analog output signal over its full range, when the 3 position manual override switch is placed in the ON position.

7. Room Sensor Support: The SDCU shall support the following two types of room sensors:

a. Type A: Room thermistor in a stainless steel cover plate with vandal proof screws

b. Type B: Room thermistor with plastic cover plate and LCD display of space temperature.

2.5 ANALOG CONTROLLERS

A. Step Controllers: 6-stage or 10-stage type, with heavy-duty switching rated to handle loads, UL listed and operated by electric motor.

B. Electric Outdoor Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range -10 to 70°F (-12 to 21°C), and single- or, double-pole contacts.

C. Electronic Controllers: Wheatstone bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.

1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

2.6 SENSORS

A. Electronic Sensors: Vibration and corrosion resistant, for wall, immersion, or duct mounting as required.

1. Resistance Temperature Detectors: Platinum.

a. Accuracy: Plus or minus 0.2 percent at calibration point.

b. Wire: Twisted, shielded-pair cable.

c. Insertion Elements in Ducts: Use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (1 sq. m).

d. Averaging Elements in Ducts: Use where ducts are larger than 9 sq. ft. (1 sq. m) or where prone to stratification, length as required.

e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).

f. Room Sensors: Match room thermostats, locking cover.

g. Outside Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

h. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

2. Humidity Sensors: Bulk polymer sensor element.

a. Accuracy: 5 percent full range with linear output.

b. Duct and Outside Air Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

3. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, temperature compensated.

a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
b. Output: 4 to 20 mA.
c. Building Static-Pressure Range: 0 to 0.25 inch wg (0 to 62 Pa).
d. Duct Static-Pressure Range: 0 to 5 inches wg (0 to 1243 Pa).

4. Pressure Transmitters: Direct acting for gas, liquid, or steam service, range suitable for system, proportional output 4 to 20 mA.

B. Equipment Operation Sensors: As follows:

1. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 5 inches wg (0 to 1243 Pa).

2. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psi (55 to 414 kPa).

3. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.

C. Valve/Damper Position Indication: Potentiometer mounted in enclosure with adjustable crank-arm assembly connected to damper to transmit 0 to 100 percent valve/damper travel.

D. Water-Flow Switches: Pressure-flow switches of bellows-actuated mercury or snap-acting type, with appropriate scale range and differential adjustment, with stainless-steel or bronze paddle. For chilled-water applications, provide vaporproof type.

E. Current Transmitters: Self-powered, solid state transmitters shall provide current usage to the BAS. Match the current and voltage of the application with associated equipment, coordinate output requirements with the BAS.

F. Current Sensors: Self-powered, solid state with adjustable trip current. Match the current and voltage of the application with associated equipment, coordinate signal with the BAS.

2.7 THERMOSTATS

A. Provide wall mount space thermostats with temperature indication, set point adjustment and override button. Indicate space temperature, set point and override status.

2.8 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or 2-position action.

1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

2. Nonspring-Return Motors for Valves Larger Than 2-1/2 Inches (DN 65): Size for running torque of 150 inch-pounds (16.9 N x m) and breakaway torque of 300 inch-pounds (33.9 N x m).

3. Spring-Return Motors for Valves Larger Than 2-1/2 Inches (64 mm): Size for running and breakaway torque of 150 inch-pounds (16.9 N x m).

4. Nonspring-Return Motors for Dampers Larger Than 25 sq. ft. (2.3 sq. m): Size for running torque of 150 inch-pounds (16.9 N x m) and breakaway torque of 300 inch-pounds (33.9 N x m).

5. Spring-Return Motors for Dampers Larger Than 25 sq. ft. (2.3 sq. m): Size for running and breakaway torque of 150 inch-pounds (16.9 N x m).

B. Electronic Operators: Select operator for full shutoff at maximum pump differential pressure.

2.9 CONTROL VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class indicated. Where type or body material is not indicated, make selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature rating of piping system.

B. Globe Pattern: As follows:

1. Up to 2 inches (DN 50): Bronze body, bronze trim, rising stem, renewable composition disc, screwed ends with backseating capacity repackable under pressure.

2. Over 2 inches (DN 50): Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc.

3. Hydronic Systems: As follows:

a. Rating: Service at 125 psi WSP (862 kPa) and 250 ºF (121 ºC).

b. Internal Construction: Replaceable plugs and seats of stainless steel or brass.

1.) Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.

c. Sizing: 3-psi (21-kPa) maximum pressure drop at design flow rate.

d. Flow Characteristics: 2-way valves have equal percentage characteristics; 3-way valves have linear characteristics. Select operators to close valves against pump shutoff head.

C. Butterfly Pattern: Iron body; bronze, aluminum-bronze, or stainless-steel disc; resilient, replaceable seat for service to 180ºF (82ºC) wafer or lug ends; extended neck.

1. Rating: Service at 125 psi WSP (862 kPa) and 250ºF (121 ºC).
2. Sizing: 1-psi (7-kPa) maximum pressure drop at design flow rate.

D. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.

1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.

2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.

3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

2.10 DAMPERS

A. Dampers: AMCA-rated, parallel or opposed blade design; form frames from not less than 0.1084-inch (2.8-mm) galvanized steel with mounting holes for duct mounting; damper blades not less than 0.0635-inch (1.6-mm) galvanized steel, with maximum blade width of 8 inches (203 mm).

1. Blades secured to 1/2-inch (13-mm) diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass. Ends sealed against spring-stainless-steel blade bearings. Thrust bearings at each end of every blade.

2. Operating Temperature Range: From -40 to 200ºF (-40 to 93ºC).

3. For standard applications as indicated, (as selected by manufacturer's sizing techniques) with optional closed-cell neoprene edging.

4. For low-leakage applications as indicated, provide parallel or opposed blade design (as selected by manufacturer's sizing techniques) with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm/sq. ft. (51 L/s/sq. m) of damper area, at differential pressure of 4 inches wg (995 Pa) when damper is being held by torque of 50 inch-pounds (5.6 N x m); test in accordance with AMCA 500.

2.11 CONTROL CABLE

A. Electronic Cable for Control Wiring: Provide all control wiring for the complete DEC Control System. Refer to Division 26 Section "Low-Voltage Electrical Power Conductors And Cables" for control wiring materials.

2.12 AIRFLOW STATIONS

A. Each airflow station shall consist of one or more sensor probes and a single, remotely mounted, microprocessor-based transmitter capable of independently processing up to 16 independently wired sensor nodes contained in one or more probe assemblies per measurement location. Each sensor node shall contain two individually wired, hermetically sealed bead-in-glass thermistors. The airflow rate at each sensor node shall be equally weighted and arithmetically averaged by the transmitter prior to output. All integrated circuitry shall be temperature rated as 'industrial-grade'.

B. Each transmitter shall have a 16-character alpha-numeric display capable of displaying airflow, temperature, system status, configuration settings and diagnostics.

C. Each sensor node, consisting of two thermistor-sensors and their structural housing, shall independently determine the airflow rate and temperature at each measurement point. Each sensor node shall be factory calibrated at a minimum of 16 airflow rates and 3 temperatures to standards that are traceable to the National Institute of Standards and Technology (NIST).

D. Airflow accuracy shall be +/-2% of Reading over the entire operating airflow range of not less than 0 to 5,000 fpm. Temperature accuracy shall be +/-0.14° F (0.08° C) over the entire operating temperature range of -20° F to 160° F (-28.9° C to 71° C)

E. Probes shall be constructed of extruded, gold anodized, 6063 aluminum tubes or optionally of Type 316 stainless steel tubes. All internal wires within the tube shall be Kynar coated. Sensor probe design shall be capable of providing up to 8 sensor nodes per probe. Each ducted sensor probe shall have an integral, U.L. Listed, plenum rated cable. Cable jackets and conductor insulation shall be FEP, Teflon-FEP or Neoflon-FEP. Cables shall include a terminal plug for connection to the remotely mounted transmitter. All terminal plug interconnecting pins shall be gold plated.

F. The transmitter shall have an integral LCD display capable of simultaneously displaying airflow and temperature. The LCD display shall be capable of displaying individual airflow and temperature readings of each independent sensor node. The transmitter shall be capable of field configuration and diagnostics using an on-board pushbutton interface and LCD display. All interconnecting pins, headers and connections on the main circuit board, option cards and cable receptacles shall be gold plated.

2.13 FLOW METER

A. Magnetic flow meter/transmitter shall be permanent, in-place flow measuring station with (2) temperature sensors. High signal flanged sensor, for stable flow measurement in the most difficult high noise applications, in conjunction with 4 to 20 mA transmitter incorporating HART protocol. Provide transmitter in enclosure that is water and dust tight, with integral 2 line, 26 character LCD display on transmitter housing for local readout indication. Provide with fully compensated mass and energy flow calculations with use of temperature sensors. Provide required accessories for remote wall mounting.

2.14 WINDOW AND OVERHEAD DOOR OPERATIONS

A. On all operable windows within areas D and G, provide window closure switches for the purpose of sending a signal to the BAS whenever a window is open. Coordinate switch locations and wiring runs with the architect and window wall system manufacturer. Provide wiring sleeves matched to mullion color and route to conceal wiring as much as possible. Coordinate with architect a means for switch concealment.

B. On all Storage and Maintenance clearstory operable window groups, provide a window closure switch for one window in each group, for the purpose of sending a signal to the BAS whenever a window is open. Coordinate groups with electrical construction drawings and electrical contractor.

C. Window Operation Indicator (WO): Provide a chrome, standard light switch sized, cover plate with green pilot light. Coordinate specific mounting locations and heights with architect.

D. For overhead doors with associated overhead door heaters (ODH), provide a contact switch or other means to signal the BAS whenever an overhead door is opening, closing or in the open position.

2.15 OPERATOR INTERFACE

A. Operator Interface. Web server shall reside on high-speed network with building controllers. Each standard browser connected to server shall be able to access all system information. In addition to the primary operator interface, the system shall include a secondary interface compatible with a locally

available commercial wireless network and viewable on a commercially available wireless device such as a Wireless Access Protocol (WAP) enabled cellular telephone or personal digital assistant (PDA). This secondary interface may be text-based and shall provide a summary of the most important data. As a minimum, the following capabilities shall be provided through this interface:

1. An operator authentication system that requires an operator to log in before viewing or editing any data, and which can be configured to limit the privileges of an individual operator.

2. The ability to view and acknowledge any alarm in the system. Alarms or links to alarms shall be provided on a contiguous list so the operator can quickly view all alarms.

3. A summary page or pages for each piece of equipment in the system. This page shall include the current values of all critical I/O points and shall allow the operator to lock binary points on or off and to lock analog points to any value within their range.

4. Navigation links that allow the operator to quickly navigate from the home screen to any piece of equipment in the system, and then return to the home screen. These links may be arranged in a hierarchical fashion, such as navigating from the home screen to a particular building, then to a specific floor in the building, and then to a specific room or piece of equipment.

B. Communication. Web server or workstation and controllers shall communicate using BACnet protocol. Web server or workstation and control network backbone shall communicate using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and BACnet/IP addressing as specified in ANSI/ASHRAE 135-2004, BACnet Annex J.

C. The operators workstation shall consist of the following:

1. Hardware Base. Industry-standard hardware shall meet or exceed DDC system manufacturer's recommended specifications and shall meet response times. Hard disk shall have sufficient memory to store system software, one year of data for trended points, and a system database at least twice the size of the existing database at system acceptance. Configure computers and network connections if multiple computers are required to meet specified memory and performance. Workstations shall be IBM-compatible PCs with a minimum of: the following:

   a. Intel Pentium based computer with minimum 3.0 GHz Ram, minimum 200 GB hard drive, video card with minimum 128 MG RAM capable of supporting a minimum of 1280 x 1024 resolution with a minimum of 32 Bit color, CD-RW, and DVD-ROM Drive, mouse and 101-key enhanced keyboard.

   b. The PC monitor shall be a flat panel type and shall support a minimum display resolution of no less than 1280 x 1024 pixels. The display shall have a minimum of 17” visible area in diagonal measurement. Separate controls shall be provided for color, contrasts and brightness. The screens hall be non-reflective.

   c. The operating system shall be Microsoft Windows 7 Professional. Include Microsoft Internet Explorer or Mozilla Firefox.

   d. Connection to the local EMS network shall be via an Ethernet network interface card.

   e. Provide a new color ink-jet system printer for printing of dynamic trend graph report, Excel reports, graphic and any other screen displays, up to 21 ppm b/w, up to 15 ppm color, up to 1200 x 1200 dpi. The printer shall have parallel and high speed USB interface.

D. Operator Functions. Operator interface shall allow each authorized operator to execute the following functions as a minimum:

1. Log In and Log Out. System shall require user name and password to log in to operator interface.

2. Point-and-click Navigation. Operator interface shall be graphically based and shall allow operators to access graphics for equipment and geographic areas using point-and-click navigation.

3. View and Adjust Equipment Properties. Operators shall be able to view controlled equipment status and to adjust operating parameters such as setpoints, PID gains, on and off controls, and sensor calibration.

4. View and Adjust Operating Schedules. Operators shall be able to view scheduled operating hours of each schedulable piece of equipment on a weekly or monthly calendar-based graphical schedule display, to select and adjust each schedule and time period, and to simultaneously schedule related equipment. System shall clearly show exception schedules and holidays on the schedule display.

5. View and Respond to Alarms. Operators shall be able to view a list of currently active system alarms, to acknowledge each alarm, and to clear (delete) unneeded alarms.

6. View and Configure Trends. Operators shall be able to view a trend graph of each trended point and to edit graph configuration to display a specific time period or data range. Operator shall be able to create custom trend graphs to display on the same page data from multiple trended points.

7. View and Configure Reports. Operators shall be able to run preconfigured reports, to view report results, and to customize report configuration to show data of interest.

8. Manage Control System Hardware. Operators shall be able to view controller status, to restart (reboot) each controller, and to download new control software to each controller.

9. Manage Operator Access. Typically, only a few operators are authorized to manage operator access. Authorized operators shall be able to view a list of operators with system access and of functions they can perform while logged in. Operators shall be able to add operators, to delete operators, and to edit operator function authorization. Operator shall be able to authorize each operator function separately.

E. System Software.

1. Operating System. Web server shall have an industry-standard professional-grade operating system. Acceptable systems include Microsoft Vista, Microsoft Windows XP Pro, Red Hat Linux, or Sun Solaris.

2. System Graphics. Operator interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone, graphics for each chilled water and hot water system, and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using dynamic colors to represent zone temperature relative to zone setpoint.

a. Functionality. Graphics shall allow operator to monitor system status, to view a summary of the most important data for each controlled zone or piece of equipment, to use point-and-click navigation between zones or equipment, and to edit setpoints and other specified parameters.

b. Animation. Graphics shall be able to animate by displaying different image files for changed object status.

c. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.

d. Format. Graphics shall be saved in an industry-standard format such as BMP, JPEG, PNG, or GIF. Web-based system graphics shall be viewable on browsers compatible with World Wide Web Consortium browser standards. Web graphic format shall require no plug-in (such as HTML and JavaScript) or shall only require widely available no-cost plug-ins (such as Active-X and Macromedia Flash).

F. System Tools. System shall provide the following functionality to authorized operators as an integral part of the operator interface or as stand-alone software programs. If furnished as part of the interface, the tool shall be available from each workstation or web browser interface. If furnished as a stand-alone program, software shall be installable on standard IBM-compatible PCs with no limit on the number of copies that can be installed under the system license.

1. Automatic System Database Configuration. Each workstation or web server shall store on its hard disk a copy of the current system database, including controller firmware and software. Stored database shall be automatically updated with each system configuration or controller firmware or software change.

2. Controller Memory Download. Operators shall be able to download memory from the system database to each controller.

3. System Configuration. Operators shall be able to configure the system.

4. Online Help. Context-sensitive online help for each tool shall assist operators in operating and editing the system.

5. Security. System shall require a user name and password to view, edit, add, or delete data.

a. Operator Access. Each user name and password combination shall define accessible viewing, editing, adding, and deleting functions in each system application, editor, and object.

b. Automatic Log Out. Automatically log out each operator if no keyboard or mouse activity is detected. Operators shall be able to adjust automatic log out delay.

c. Encrypted Security Data. Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.

6. System Diagnostics. System shall automatically monitor controller and I/O point operation. System shall annunciate controller failure and I/O point locking (manual overriding to a fixed value).

7. Alarm Processing. System input and status objects shall be configurable to alarm on departing from and on returning to normal state. Operator shall be able to enable or disable each alarm and to configure alarm limits, alarm limit differentials, alarm states, and alarm reactions for each system object. Configure and enable alarm points as specified in Section 230993 Sequence of Operations for HVAC Controls or shown on the drawings. Alarms shall be BACnet alarm objects and shall use BACnet alarm services.

8. Alarm Messages. Alarm messages shall use an English language descriptor without acronyms or mnemonics to describe alarm source, location, and nature.

9. Alarm Reactions. Operator shall be able to configure (by object) actions workstation or web server shall initiate on receipt of each alarm. As a minimum, workstation or web server shall be able to log, print, start programs, display messages, send e-mail, send page, and audibly annunciate.

10. Alarm Maintenance. Operators shall be able to view system alarms and changes of state chronologically, to acknowledge and delete alarms, and to archive closed alarms to the workstation or web server hard disk from each workstation or web browser interface.

11. Trend Configuration. Operator shall be able to configure trend sample or change of value (COV) interval, start time, and stop time for each system data object and shall be able to retrieve data for use in spreadsheets and standard database programs. Controller shall sample and store trend data and shall be able to archive data to the hard disk. Configure trends as specified in Section 230993 Sequence of Operations for HVAC Controls. Trends shall be BACnet trend objects.

12. Object and Property Status and Control. Operator shall be able to view, and to edit if applicable, the status of each system object and property by menu, on graphics, or through custom programs.

13. Reports and Logs. Operator shall be able to select, to modify, to create, and to print reports and logs. Operator shall be able to store report data in a format accessible by standard spreadsheet and word processing programs.

14. Standard Reports. Furnish the following standard system reports:

    a. Objects. System objects and current values filtered by object type, by status (in alarm, locked, normal), by equipment, by geographic location, or by combination of filter criteria.

    b. Alarm Summary. Current alarms and closed alarms. System shall retain closed alarms for an adjustable period.

    c. Logs. System shall log the following to a database or text file and shall retain data for an adjustable period:

        1.) Alarm History.

        2.) Trend Data. Operator shall be able to select trends to be logged.

        3.) Operator Activity. At a minimum, system shall log operator log in and log out, control parameter changes, schedule changes, and alarm acknowledgment and deletion. System shall date and time stamp logged activity.

15. Environmental Index. System shall monitor all occupied zones and compile an index that provides a numerical indication of the environmental comfort within the zone. As a minimum, this indication shall be based upon the deviation of the zone temperature from the heating or cooling setpoint. If humidity is being measured within the zone then the environmental index shall be adjusted to reflect a lower comfort level for high or low humidity levels. Similarly, if carbon dioxide levels are being measured as an indication of ventilation effectiveness then the environmental index shall be adjusted to indicate degraded comfort at high carbon dioxide levels. Other adjustments may be made to the environmental index based upon additional measurements. The system shall maintain a trend of the environmental index for each zone in the trend log. The system shall also compute an average comfort index for every building included in this contract and maintain trend logs of these building environmental indices. Similarly, the system shall compute the percentage of occupied time that comfortable conditions were maintained within the zones. Through the UI

the user shall be able to add a weighting factor to adjust the contribution of each zone to the average index based upon the floor area of the zone, importance of the zone, or other static criteria.

16. Graphics Generation. Graphically based tools and documentation shall allow Operator to edit system graphics, to create graphics, and to integrate graphics into the system. Operator shall be able to add analog and binary values, dynamic text, static text, and animation files to a background graphic using a mouse.

17. Graphics Library. Complete library of standard HVAC equipment graphics shall include equipment such as chillers, boilers, air handlers, terminals, fan coils, and unit ventilators. Library shall include standard symbols for other equipment including fans, pumps, coils, valves, piping, dampers, and ductwork. Library graphic file format shall be compatible with graphics generation tools.

18. Custom Application Programming. Operator shall be able to create, edit, debug, and download custom programs. System shall be fully operable while custom programs are edited, compiled, and downloaded. Programming language shall have the following features::

    a. Language. Language shall be graphically based and shall use function blocks arranged in a logic diagram that clearly shows control logic flow. Function blocks shall directly provide functions listed below, and operators shall be able to create custom or compound function blocks.

    b. Programming Environment. Tool shall provide a full-screen, cursor-and-mouse-driven programming environment that incorporates word processing features such as cut and paste. Operators shall be able to insert, add, modify, and delete custom programming code, and to copy blocks of code to a file library for reuse in other control programs.

    c. Independent Program Modules. Operator shall be able to develop independently executing program modules that can disable, enable and exchange data with other program modules.

    d. Debugging and Simulation. Operator shall be able to step through the program observing intermediate values and results. Operator shall be able to adjust input variables to simulate actual operating conditions. Operator shall be able to adjust each step's time increment to observe operation of delays, integrators, and other time-sensitive control logic. Debugger shall provide error messages for syntax and for execution errors.

    e. Conditional Statements. Operator shall be able to program conditional logic using compound Boolean (AND, OR, and NOT) and relational (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.

    f. Mathematical Functions. Language shall support floating-point addition, subtraction, multiplication, division, and square root operations, as well as absolute value calculation and programmatic selection of minimum and maximum values from a list of values.

    g. Variables: Operator shall be able to use variable values in program conditional statements and mathematical functions.

        1.) Time Variables. Operator shall be able to use predefined variables to represent time of day, day of the week, month of the year, and date. Other predefined variables or simple control logic shall provide elapsed time in

seconds, minutes, hours, and days. Operator shall be able to start, stop, and reset elapsed time variables using the program language.

2.) System Variables. Operator shall be able to use predefined variables to represent status and results of Controller Software and shall be able to enable, disable, and change setpoints of Controller Software as described in Controller Software section.

G. Portable Operator's Terminal. Provide all necessary software to configure an IBM-compatible laptop computer for use as a Portable Operator's Terminal. Operator shall be able to connect configured Terminal to the system network or directly to each controller for programming, setting up, and troubleshooting.

H. BACnet. Web server or workstation shall have demonstrated interoperability during at least one BMA Interoperability Workshop and shall substantially conform to BACnet Operator Workstation (B-OWS) device profile as specified in ASHRAE/ANSI 135-2004, BACnet Annex J.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation. Verify that field end devices, wiring, and pneumatic tubing are installed before proceeding with installation.

B. Coordinate flow meter sensor requirements with manufacturer and provide sensors and accessories.

3.2 INSTALLATION

A. Install equipment as indicated to comply with manufacturer’s written instructions.

B. Install software in control units and operator workstation. Implement all features of programs to specified requirements and appropriate to sequence of operation.

C. Connect and configure equipment and software to achieve the sequence of operation specified.

D. Verify location of thermostats, humidity sensors, and other exposed control sensors with plans and room details before installation. Locate 48 inches (1524 mm) above floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

E. Provide temperature sensors of type and location as indicated below:

1. Type A Sensor (Stainless Steel Cover Plate):

a. Entrances.
b. Public areas.
c. Locker rooms/Shower rooms
d. Racquetball Courts
e. Gymnasium
f. Fitness Center/Strength Training
g. Storage Rooms
h. Classrooms and Labs

2. Type B Sensor (Plastic Cover Plate with LCD Temperature Display):

a. Offices
b. Conference Rooms

F. Each temperature sensors shall be field calibrated to within 1°F of the control system set-point after installation.

G. Install damper motors on outside of duct in warm areas, not where exposed to outdoor temperatures.

H. Install labels and nameplates to identify control components according to Division 23 Sections specifying mechanical identification.

I. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."

J. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

K. Install flow meters for piping systems located in accessible locations at most readable position. Install minimum straight lengths of pipe upstream and downstream from element as prescribed by the manufacturer's installation instructions.

L. Coordinate CO/NOx sensor wiring requirements and signal type with electrical contractor. Provide required wiring and devices necessary for BAS to accept CO/NOx sensor signals. Provide separate CO and NOx inputs to the BAS, and represent signals separately on graphics screens. Signals from multiple sensors shall be associated with each respective RTU.

3.3 ELECTRICAL WIRING AND CONNECTIONS

A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceways and boxes."

B. Install building wire and cable according to Division 26 Section "Control-Voltage electrical power cables."

C. Install signal and communication cable according to Division 26 Section "Control-Voltage electrical power cables."

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.

2. Install exposed cable in raceway.

3. Install concealed cable in raceway.

4. Bundle and harness multiconductor instrument cable in place of single cables where a number of cables follow a common path.

5. Fasten flexible conductors, bridging cabinets and doors, neatly along hinge side; protect against abrasion. Tie and support conductors neatly.

6. Number-code or color-code conductors, except local individual room controls, for future identification and servicing of control system.

D. Connect electrical components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's

torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

E. Connect manual reset limit controls independent of manual control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

F. Connect HAND-OFF-AUTO selector switches to override automatic interlock controls when switch is in HAND position.

3.4 COMMISSIONING

A. Manufacturer's Field Services: Provide the services of a factory-authorized service representative to start control systems.

B. Test and adjust controls and safeties.

C. Replace damaged or malfunctioning controls and equipment.

D. Start, test, and adjust control systems.

E. Demonstrate compliance with requirements.

F. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

3.5 DEMONSTRATION

A. Manufacturer's Field Services: Provide the services of a factory-authorized service representative to demonstrate and train Owner's maintenance personnel as specified below.

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

2. Schedule training with Owner with at least 7 days' notice.

3. Provide the following operator training at a minimum:

a. Four – 8 hour sessions totaling 32 hours in building automation training. Training shall be broken up into the following sessions:

1.) Two – 8 hour sessions at system start

2.) One – 8 hour sessions during the warranty period – exact time and date to be determined by the Owner

3.) One – 8 hour session at the end of the warranty period.

b. Training shall include a complete review of

1.) Data displayed
2.) Alarm and status descriptors
3.) Requesting data
4.) Execution of commands
5.) Request of logs and development of trends
6.) Trouble shooting technics

END OF SECTION 230900

SECTION 230993 SEQUENCE OF OPERATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. The work included in this specification consists of furnishing all labor, material, accessories and equipment necessary for a complete, operational temperature control system as described herein.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-3(l), 16a-38k-4(a)11, 16a-38k-4(b)11.

2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed. Division 23 Section 230900 Instrumentation and Control for HVAC contains requirements that relate to this Section.

C. The following specification sections contain requirements that relate to this section:

1. 260501 – Basic Electrical Materials & Methods
2. 260533 – Raceways and Boxes for Electrical Ssystems
3. 260519 – Building Wire and Cable
4. 260553 – Electrical Identification
5. 260526 – Grounding and Bonding for Electrical Systems
6. 262813 – Fuses
7. 262416 – Panelboards and Circuit Breakers

1.3 SUBMITTALS

A. Refer to Section 230900 Instrumentation and Control for HVAC for submittal requirements.

1.4 DEFINITIONS

A. Point Types:

1. Digital Input - DI
2. Digital Output - DO
3. Analog Output - AO
4. Analog Input - AI

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to the Electrical Demand Monitoring and Trending Measurement and Verification Plan section for equipment energy usage trending requirements. Provide the required sensors and devices necessary to trend energy usage for the equipment listed. Coordinate provision of energy usage signals which

may be standard from the equipment manufacturer, available from electric meters at panels (provided by electrical contractor), or added per this specification section.

B. All setpoints and schedules shall be adjustable by the owner through operator interface with no additional programming required. Coordinate the various levels of security and access with the Facilities Maintenance Supervisor.

C. Provide control components compatible with individual manufacturer's equipment.

D. Provide wall mount space thermostats with temperature indication, set point adjustment and override button. Indicate space temperature, set point and override status.

1. Provide space temperature sensors only in Spaces associated with RTU-7, Spaces associated with RTU-9, Lobby A201, Vestibules, Stairs, Corridors, Toilet rooms and Locker rooms.

2. Space temperature shall be monitored using RTU return air duct temperature sensors for the following areas: Bus Storage S113, Maintenance M104 & M108, Chassis Wash M103, Service Lanes S111 & Bus Wash S112.

3. Spaces served by Cabinet Unit Heaters (CUH) and Unit Heaters (UH) not shown with associated temperature sensors shall be provided with unit mounted temperature sensors in the return airstream.

E. Provide Window Operation Indicators where shown on construction drawings. Provide wall plate with red and green LEDs mounted at 6ft above finished floor, for the purpose of notifying occupants whenever outdoor temperature and humidity conditions are suitable for opening windows.

F. Upon a signal from a the fire alarm panel, HVAC air handling equipment shall be shut down and outside air dampers shall close, with the exception of vehicle exhaust systems. The controls contractor shall provide wring, conduit and all necessary devices from the fire control panel to the Building Automation System (BAS). When the fire alarm signal has cleared, each unit shall revert to its scheduled operating mode.

G. Provide data jacks for BAS laptop access in control cabinets of all RTUs and Boiler Room M130.

H. Provide starters/contactors/relays required for the control of HVAC equipment that are not provided by equipment manufacturers or electrical contractor.

I. Current transmitters shall be provided on each electrical power leg of equipment noted in points lists for the purpose of monitoring energy usage. Variable frequency drives on fan motors and pumps shall provide energy usage output. Provide all devices and components necessary for reading and trending max kWh and max kW for each piece of equipment. Refer to 'Electrical Demand Monitoring and Trending' within this specification section.

J. Current transmitters shall be provided on each electrical power leg of electrical panels serving lighting. Provide all devices and components necessary for reading and trending max kWh and max kW for each electrical panel. Refer to 'Electrical Demand Monitoring and Trending' within this specification section.

K. Note considerable distance to Guard Booth from facility building. Controls contractor shall provide all conduit and/or controls devices and components necessary for communications with the Guard Booth.

L. Provide the following general points for monitoring and use as required by individual equipment and terminal unit operating sequences.

Points List:

Point ID	Description	Type	Remarks
G-1	Outdoor Air Temperature	AI	
G-2	Outdoor Air Humidity	AI	
G-3	Outdoor Air CO2 Concentration	AI	
G-4	Fire Alarm Status	DI	
G-5	CO & NOx Sensors (See electrical plans)	AI	Separate CO & NOx inputs from multiple sensors
G-6	Gas Service Meter	AI	Gas usage
G-7	Water Meter	AI	Water usage
G-8	Electrical Panel Current Transmitters	AI	Multiple current transmitters, on each electrical power leg, for trending total electrical usage – Multiple panels
G-9	Alarms to Security Systems	DO	Multiple - Coordinate alarm types with owner's representative

3.2 HEATING PLANT

A. Points List:

Point ID	Description	Type	Remarks
Boilers B-1/2/3/4	Boiler Enable/Disable	DO	
Boilers B-1/2/3/4	Boiler Status	DI	Monitor Boiler Control Panel Alarm
Boilers B-1/2/3/4	Boiler Management System		Provide (6) points for monitoring system
Boilers B-1/2/3/4	Boiler Current Sensors	AI	Multiple current transmitters, on each electrical power leg, for trending total electrical usage
Boilers B-1/2/3/4	Boiler Supply Water Temperature	AI	
Boilers	Boilers Gas Usage	AI	Boiler gas meter output
Pumps BP-1/2/3/4	Boiler Pump Start / Stop	DO	
Pumps BP-1/2/3/4	Bldg Pump Flow Status	DI	Current transmitter
Pumps BP-1/2/3/4	Boiler Pump Current Transmitters	AI	Multiple current transmitters, on each electrical power leg, for trending total electrical usage
Pumps P-1&2	Bldg Distribution Pump Start / Stop	DO	
Pumps	Bldg Distribution Pump Status	DI	Current sensor

Point ID	Description	Type	Remarks
P-1&2			
Pumps P-1&2	Bldg Distribution Pump Speed	AO	Variable Frequency Drive
Pumps P-1&2	Bldg Distribution Pump Energy Output from Variable Frequency Drive	AI	
HHW System	Distribution Loop Supply Temperature	AI	Downstream of P-1A/B
HHW System	Distribution Loop Return Temperature	AI	Upstream of Boiler take offs
HHW System	Piping System Differential Pressure	AI	
HHW SYSTEM	Piping System Flow	AI	
GLYCOL INJECTION SYSTEM	Alarm	DI	Monitor system alarm

B. Heating:

1. Coordinate sequence with boiler manufacturer's boiler management system. On boiler graphics screen show return water temperature and respective boiler's supply water temperature.

2. Whenever the OAT is below 60 degrees, the designated lead primary building distribution pump shall start and run continuously. Above 60 degrees OAT the pumps shall be off. If proof of flow is not established by the lead building distribution pump, the standby pump shall start and an alarm shall be generated. Lead and standby pump assignments shall be determined by the BAS based on overall runtime and number of starts. The lead pump speed shall vary to maintain system differential pressure setpoint; on a loss of the differential pressure signal, the lead pump shall default to 50% pump speed and an alarm shall be generated.

3. When the lead pump has proven operation for at least one minute, the boilers shall be enabled and the boiler manufacturer's control panel shall control the boilers. The boilers shall provide the discharge water temperature necessary to maintain the building distribution water supply temperature as determined by the reset schedule. Provide all necessary control devices and wiring necessary for the control panel to operate the boilers and respective boiler pumps.

   a. Each boiler's circulation pump shall prove operation for at least one minute before the boiler fires. An alarm shall be generated whenever a pump does not prove operation, and the next pump/boiler in sequence shall be brought on line.

   b. Boiler circulation pump speed shall be manually adjustable through the BAS graphic screens.

4. Provide building distribution water supply temperature reset based on ambient temperature. Also provide a manual water supply temperature setpoint schedule which overrides the reset schedule – heating plant graphics screens shall indicate manual override operation whenever it is engaged.

Ambient Air Temperature	Building Distribution Hot Water Supply Temperature
0°F	140°F
60°F	90°F

5. If the heating hot water supply temperature varies by more than 10°F from setpoint, an alarm shall be generated.

6. The BAS shall monitor the alarm status of each boiler's on board controller, the boiler management system and the glycol injection system, and initiate a BAS alarm.

3.3 VARIABLE AIR VOLUME H/C ROOFTOP UNITS
RTU-11/12/13

A. Points List:

Point ID	Description	Type	Remarks
RTU	Supply Fan Start/Stop	DO	
RTU	Supply Fan Status	DI	Current sensor
RTU	Supply Fan Speed	AO	Display on respective unit's graphic screen
RTU	Duct Static Pressure	AI	Locate sensors approx. 2/3 downstream of supply fan
RTU	Exhaust Fan Start/Stop	DO	
RTU	Exhaust Fan Status	DI	Current sensor
RTU	Exhaust Fan Speed	AO	Display on respective unit's graphic screen
RTU	Supply Air Temperature	AI	Ductstat
RTU	Return Air Temperature	AI	Ductstat
RTU	Mixed Air Temperature	AI	
RTU	Heating Coil Control Valve	AO	Modulating Actuator
RTU	Cooling Stages Start/Stop	DO	For each stage
RTU	Return Air Damper	AO	Modulating Actuator
RTU	Outside Air Damper	AO	Modulating Actuator
RTU	Supply Airflow – Array for each fan	AI	Display on respective unit's graphic screen
RTU	Return Airflow– Array for each fan	AI	Display on respective unit's graphic screen
RTU	Outside Airflow	AI	Display on respective unit's graphic screen
RTU	Energy Recovery Wheel Rotation	DO	
RTU	Filter Status	DI	Differential Press Switch
RTU	Duct Smoke Detectors	DI	Multiple
RTU	Space Humidity	AI	Duct humidistat. Display on respective unit's graphic screen
RTU	RTU Supply Fan Energy Output from Variable Frequency Drive	AI	
RTU	RTU Exhaust Fan Energy Output from Variable Frequency Drive	AI	
RTU	RTU Compressor Current Transmitters (for each compressor)	AI	Multiple current transmitters, on each electrical power leg, for trending total electrical usage
RTU	CO2 Concentration Rooms A115, A202, A212, M101, M131	AI	Monitor

B. The rooftop units shall operate in either Occupied, Unoccupied, Warmup or Cooldown modes as scheduled. Optimization programming shall determine start time of occupancy mode. The energy recovery wheel shall rotate only when the unit is in occupied mode, except the wheel shall stop whenever the unit is in economizer operation.

C. During Occupied mode, the supply and exhaust fans shall operate continuously and the outside air damper shall modulate to provide the minimum ventilation air requirement.

1. The supply fan variable frequency drive shall vary the supply fan speed to maintain the duct static pressure setpoint, which shall be automatically reset to meet zone airflow demands. The exhaust fan variable frequency drive shall modulate the exhaust fan speed to maintain building pressurization control via airflow station data.

   a. Coordinate initial balance fan speed settings with the balance contractor to determine the supply and exhaust fan speeds at maximum design supply and exhaust airflows. Note the VFD frequency settings as "MAX DESIGN AIRFLOW" for each, plainly visible, in the control cabinet adjacent to the VFD. Provide a list of RTU unit designations and the noted frequencies/airflows accessible through the controls system as a reference document.

2. The outside air damper and exhaust fan speed shall modulate to maintain building pressurization, via airflow station data, and to ensure the minimum ventilation airflow requirements are met.

3. The heating coil normally closed control valve shall modulate to maintain the discharge air temperature setpoint 55°F (adjustable).

4. The cooling stages shall cycle to maintain the discharge air temperature setpoint 55°F.

   a. Provide differential enthalpy economizer operation to modulate outside air and return air dampers from minimum outdoor air position to 100% outdoor air to maintain space temperature setpoint. Optimization control shall cycle cooling stages during economizer operation if deemed efficient to do so. The exhaust fan speed shall modulate to maintain building pressurization. Provide mixed air low limit control to prevent mixed air temperature from dropping below the discharge air temperature setpoint. During economizer operation the energy recovery wheel shall stop.

   b. Whenever an air handling unit's return air relative humidity (RH) is below setpoint 50% (adjustable), the respective unit's discharge air temperature shall be reset upward to maintain 80 to 95% airflow through the VAV box with the most cooling demand. If airflow through the most demanding VAV box drops below 80%, the discharge air temperature shall be reset to 65°F. If airflow through the most demanding VAV box rises toward 95%, the discharge air temperature shall be reset to 55°F.

D. During Unoccupied mode, the supply and exhaust fans shall stop, the outside air damper shall close and the return air damper shall fully open, unless night purge is active.

1. Whenever any space temperature drops below the unoccupied setpoint temperature 60°F, the respective unit's supply fan shall operate at full airflow and the heating coil control valve shall fully open. The supply fan shall stop and the coil valve shall close when all spaces reach the unoccupied setpoint temperature.

   a. Provide an adjustable time delay to prevent the supply fan from starting again until time delay has expired (default -15 minutes). If the number of supply fan cycles exceeds an operator adjustable maximum cycles (default - 8) during an unoccupied period, the fan shall run continuously until the end of the next scheduled occupied period.

2. Night Purge shall be enabled whenever the average of space temperatures for a respective air handling unit system is above 75 °F, the outdoor air temperature is above 50°F and the outdoor air dewpoint is below 60°F. During Night Purge the outside air and exhaust air dampers shall fully open, and the supply and exhaust fans shall operate continuously at full airflow. Night Purge shall cease whenever the average space temperature drops below 75°F, or the outdoor air temperature drops below 50°F, or the outdoor air dewpoint rises above 60°F , or the outdoor air temperature is less than 5°F cooler than the average space temperature.

3. Upon activation of the unoccupied mode override, the unit control shall revert to occupied mode operation for an operator defined interval (default – 2 hrs).

E. During Warmup, the outside air dampers shall be closed, the return air damper shall be fully open, the exhaust fan shall be off, the supply fan shall operate continuously, the heating coil control valve shall modulate to maintain a minimum 55°F supply air temperature, and the VAV box reheat coils shall

operate in occupied mode. When all spaces reach their occupied space temperature setpoint, the system shall revert to occupied mode operation.

F. During Cooldown, the outside air damper shall be closed, the return air damper shall be fully open, the exhaust fan shall be off, the supply fan shall operate continuously, the cooling stages shall cycle to maintain the occupied discharge air temperature setpoint and the respective system's VAV boxes shall operate in occupied mode. When all spaces reach their occupied space temperature setpoint, the system shall revert to occupied mode operation.

G. Monitor the unit's filter differential pressure switch and generate an alarm for dirty filters (default - 0.5" wc above clean filter).

H. Safety Controls:

1. The duct smoke detectors auxiliary contacts shall be hard-wired into the respective unit's fan control circuits to shut down the fans upon activation. Shut down fans and close outdoor air damper whenever the building fire alarm is activated. Restart units when the alarm signal is cleared.

3.4 AIR TERMINAL VAV BOXES AND FINNED TUBE RADIATION

A. Points List:

Point I.D.	Description	Type	Remarks
VAV	Space Temperature Sensor	AI	
VAV	Space Temperature Setpoint	AI	
VAV	Supply Airflow	AI	
VAV	Supply Airflow Damper	AO	Modulating Actuator
VAV	Supply Air Temperature	AI	
VAV	Coil Control Valve	AO	Modulating Actuator
Space	Space Temperature Sensor	AI	
Space	Space Temperature Setpoint	AI	
Space	Unoccupied Mode Override Button	DI	
Space	Open Window Signal	DI	All operable windows in areas D and G
Space	Window Operation Indicator (Green pilot light)	DO	Lit when conditions are favorable
FT	Finned Tube Control Valve Open/Close	DO	Modulating

B. The air terminals shall operate in either Occupied, Unoccupied, Warmup or Cooldown modes as scheduled. Finned tube radiation shall be enabled during occupied mode. Provide a range of outdoor air temperatures and outdoor humidity conditions within which ambient conditions are favorable for opening windows by the building occupants. Under favorable conditions the Window Operation Indicator (WO) shall be lit.

C. During Occupied mode, Warmup and Cooldown:

1. On a rise in space temperature from 75°F setpoint, the VAV box damper shall modulate from minimum damper position to maximum airflow to maintain the space setpoint temperature for cooling. The coil control valve shall be closed. When the space temperature is satisfied the damper shall be at minimum position.

2. On a drop in space temperature from 70°F setpoint, the VAV box shall be in minimum damper position and the heating coil control valve shall modulate to satisfy the space temperature setpoint for heating. For spaces with radiation heating, the radiation shall integrate with VAV box control.

a. For each VAV box, provide a heating mode damper position, a cooling mode minimum ventilation damper position and a window open damper position. Whenever a window is open, the respective VAV box damper shall maintain the window open damper position.

3. Enable finned tube heating whenever OAT is below 65°F. Integrate finned tube radiation as primary heat source with VAV box operation. Modulate finned tube control valve to maintain space temperature occupied setpoint.

4. During occupied mode, whenever one or more windows in a space is open, the damper of the VAV air terminal serving the space shall fully close.

D. During Unoccupied mode:

1. The VAV boxes dampers shall be open for full airflow, for unoccupied heating and Night Purge operation.

3.5 CONSTANT VOLUME ROOFTOP H/C UNITS RTU-14 & 15

A. Points List:

Point ID	Description	Type	Remarks
RTU	Supply Fan Start/Stop	DO	
RTU	Supply Fan Status	AI	Current sensor
RTU	Supply Fan Speed	AO	Manual setting
RTU	Exhaust Fan Start/Stop	DO	
RTU	Exhaust Fan Status	AI	Current sensor
RTU	Exhaust Fan Speed	AO	Manual setting
RTU	Supply Air Temperature	AI	Ductstat
RTU	Return Air Temperature	AI	Ductstat
RTU	Mixed Air Temperature	AI	
RTU	Heating Coil Control Valve	AO	Modulating Actuator
RTU	Cooling Stages Start/Stop	DO	For each stage
RTU	Return Air Damper	AO	Modulating Actuator
RTU	Outside Air Damper	AO	Modulating Actuator
RTU	Supply Airflow – Array for each fan	AI	Display on respective unit's graphic screen
RTU	Return Airflow	AI	Display on respective unit's graphic screen
RTU	Outside Airflow	AI	Display on respective unit's graphic screen
RTU	Filter Status	DI	Differential Press Switch
RTU	Space Humidity	AI	Duct Humidistat. Display on respective unit's graphic screen
RTU	RTU Supply Fan Energy Output from Variable Frequency Drive	AI	
RTU	RTU Exhaust Fan Energy Output from Variable Frequency Drive	AI	
RTU	RTU Compressor Current Transmitters (for each compressor)	AI	Multiple current transmitters, on each electrical power leg, for trending total electrical usage

B. The rooftop units shall operate in either Occupied, Unoccupied, Warmup or Cooldown modes as scheduled. Optimization programming shall determine start time of occupancy mode.

C. During Occupied mode, the supply and exhaust fans shall operate continuously and the outside air damper shall modulate to provide the minimum ventilation air requirement.

1. Coordinate initial balance fan speed settings with the balance contractor to determine the design supply and exhaust fan speeds. Note the VFD frequency settings as “DESIGN AIRFLOW” for each, plainly visible, in the control cabinet adjacent to the VFD. Provide a list of RTU unit designations and the noted frequencies/airflows accessible through the controls system as a reference document

2. The heating coil normally closed control valve shall modulate to maintain the discharge air temperature setpoint 55°F (adjustable).

3. The cooling stages shall cycle to maintain the discharge air temperature setpoint 55°F.

a. Provide differential enthalpy economizer operation to modulate outside air and return air dampers from minimum outdoor air position to 100% outdoor air to maintain space temperature setpoint. Optimization control shall cycle cooling stages during economizer operation if deemed efficient to do so. The exhaust fan speed shall modulate to maintain building pressurization. Provide mixed air low limit control to prevent mixed air temperature from dropping below s the discharge air temperature setpoint.

D. During Unoccupied mode, the supply and exhaust fans shall stop, the outside air damper shall close and the return air damper shall fully open, unless night purge is active.

1. Whenever space temperature drops below the unoccupied setpoint temperature 60°F, the respective unit’s supply fan shall operate at full airflow and the heating coil control valve shall fully open. The supply fan shall stop and the coil valve shall close when all spaces reach the unoccupied setpoint temperature.

a. Provide an adjustable time delay to prevent the supply fan from starting again until time delay has expired (default -15 minutes). If the number of supply fan cycles exceeds an operator adjustable maximum cycles (default - 8) during an unoccupied period, the fan shall run continuously until the end of the next scheduled occupied period.

2. Night Purge shall be enabled whenever the average of space temperatures for a respective air handling unit system is above 75 °F, the outdoor air temperature is above 50°F and the outdoor air dewpoint is below 60°F. During Night Purge the outside air and exhaust air dampers shall fully open, and the supply and exhaust fans shall operate continuously at full airflow. Night Purge shall cease whenever the average space temperature drops below 75°F, or the outdoor air temperature drops below 50°F, or the outdoor air dewpoint rises above 60°F , or the outdoor air temperature is less than 5°F cooler than the average space temperature.

3. Upon activation of the unoccupied mode override, the unit control shall revert to occupied mode operation for an operator defined interval (default – 2 hrs).

E. During Warmup, the outside air dampers shall be closed, the return air damper shall be fully open, the exhaust fan shall be off, the supply fan shall operate continuously, the heating coil control valve shall fully open. When the space has reached occupied space temperature setpoint, the system shall revert to occupied mode operation.

F. During Cooldown, the outside air damper shall be closed, the return air damper shall be fully open, the exhaust fan shall be off, the supply fan shall operate continuously, the cooling stages shall cycle to maintain the occupied discharge air temperature setpoint. When the space has reached occupied space temperature setpoint, the system shall revert to occupied mode operation.

G. Monitor the unit’s filter differential pressure switch and generate an alarm for dirty filters (default - 0.5” wc above clean filter).

H. Safety Controls:

1. Shut down fans and close outdoor air damper whenever the building fire alarm is activated. Restart units when the alarm signal is cleared.

3.6 ENERGY RECOVERY ROOFTOP UNITS RTU-1 THRU 10

A. Points List:

Point ID	Description	Type	Remarks
RTU	Supply Fan Start/Stop	DO	
RTU	Supply Fan Status	AI	Current sensor
RTU	Supply Fan Speed	AO	Display on respective unit's graphic screen
RTU	Exhaust Fan Start/Stop	DO	
RTU	Exhaust Fan Status	AI	Current sesnor
RTU	Exhaust Fan Speed	AO	Display on respective unit's graphic screen
RTU	Supply Air Temperature	AI	Ductstat
RTU	Return Air Temperature	AI	Ductstat
RTU	Mixed Air Temperature	AI	
RTU	Heating Coil Control Valve	AO	Modulating Actuator
RTU	Bypass Air Damper	AO	Modulating Actuator
RTU	Outside Air Damper	AO	Modulating Actuator
RTU	Heat Exchanger Bypass damper	AO	
RTU	Supply Airflow – Array for each fan	AI	Display on respective unit's graphic screen
RTU	Exhaust Airflow– Array for each fan	AI	Display on respective unit's graphic screen
RTU	Outside Airflow	AI	Display on respective unit's graphic screen
RTU	Filter Status	DI	Differential Press Switch
RTU	Duct Smoke Detectors	DI	Multiple
RTU	Return Duct Temperature Sensor	AI	
RTU	Space Temperature Setpoint	AI	
RTU-7, 8 & 9	Space Temperature Sensor	AI	Multiple
RTU-7, 8 & 9	Space Temperature Setpoint	AI	Average – selectable inclusion and priority
RTU	Space CO/NOx Sensor Separate CO and NOx readings	DI	Multiple for each unit
RTU	RTU Supply Fan Energy Output from Variable Frequency Drive	AI	
RTU	RTU Exhaust Fan Energy Output from Variable Frequency Drive	AI	

B. The air handling units shall operate continuously. RTUs are provided with manufacturer's defrost controls and associated on-board dampers and devices. Provide associated startup services for defrost operation. Separate CO & NOx readings from multiple sensors shall be associated with each rooftop unit.

C. During Occupied mode, the supply and exhaust fans shall operate continuously. Provide night purge operation.

1. Coordinate initial balance fan speed settings with the balance contractor to determine the design supply and exhaust fan speeds. Note the VFD frequency settings as "DESIGN AIRFLOW" for each, plainly visible, in the control cabinet adjacent to the VFD. Provide a list of RTU unit designations and the noted frequencies/airflows accessible through the controls system as a reference document.

2. The heating coil control valve shall modulate to maintain the discharge air temperature setpoint to satisfy space temperature (Bus Storage: 55 degrees F – Maintenance Area: 68 degrees F)

   a. RTU-7, 8 & 9: Provide settings for an average space temperature to drive the system, polling the respective space temperature sensors with selectable inclusion and priority, and settings for any one of the space temperature sensors to drive the system.

   b. The unit manufacturer's on-board controls shall initiate defrost control to prevent frosting of the heat exchanger. Coordinate BAS requirements with RTU manufacturer.

3. Provide a high limit CO setpoint and a high limit NOx setpoint (PPM) and minimum ventilation airflow rate (CFM). The CO/NOx levels shall be monitored continuously. Below the high limit, the supply fan and exhaust fan shall modulate fan speed to provide the minimum ventilation airflow rate. Whenever any CO/NOx sensor exceeds the upper limit setpoint, the associated rooftop units shall provide 100% outside air and exhaust until the levels drop below the upper limit.

   a. RTU-8 & 9 shall operate at full airflow, 100% outside air and exhaust air at all times.

   b. The RTU-8 exhaust fan shall reduce airflow by 800 cfm for each hose reel fan in operation.

D. Monitor the unit's filter differential pressure switch and generate an alarm for dirty filters (default - 0.5" wc above clean filter).

E. Safety Controls:

1. The duct smoke detector auxiliary contacts shall be hard-wired into the respective unit's fan control circuits to shut down the fans upon activation. Shut down fans and close outdoor and exhaust air dampers whenever the building fire alarm is activated. Restart units when the alarm signal is cleared.

2. Provide a set of contacts to close whenever RTU-7 status indicates proper unit operation, for the purpose of enabling fuel dispensers. Provide wiring from contact to fuel dispenser control panels. Coordinate with fuel dispenser controls technician.

3.7 SPLIT SYSTEMS

A. Points List:

Point I.D.	Description	Type	Remarks
AC, HPC	Split System Enable/Disable	DO	
AC, HPC, FC	Fan Status	AI	Current transmitter
HPC	Ventilation Fan Status	AI	Current transmitter
AC& FC	Space Temperature Sensor	AI	AC: High temperature alarm
AC & FC	Space Temperature Setpoint	AI	AC: High temperature alarm
FC	Heating Coil Control Valve	AO	
ACCU	ACCU Compressor Start/Stop	DO	
ACCU	ACCU Compressor Current Transmitters	AI	Multiple current transmitters, on each electrical power leg, for trending total electrical usage
AC, FC, HPC VENTILATI ON FAN	Fan Motor Current Transmitters	AI	Multiple current transmitters, on each electrical power leg, for trending total electrical usage

B. For AC and HPC systems temperature controls are provided by the manufacturer with BAS capability to enable/disable; provide individual system schedules. In spaces with the symbol TA, a separate space temperature sensor (no adjustment) shall be provided to alarm whenever the high limit temperature setpoint is exceeded. Provide interconnecting wiring between indoor units and respective ACCUs, and between HPC and respective ventilator fans.

C. The FC-1/ACCU-16 split systems shall operate in either occupied or unoccupied mode as scheduled.

D. During occupied mode the FC-1 fan unit shall operate continuously, the ACCU-16 compressor shall cycle to maintain space temperature setpoint. The FC-1 heating coil control valve shall modulate to maintain space temperature setpoint; cooling or heating operation shall be locked out whenever the opposite mode is engaged.

E. During unoccupied mode the indoor fan unit shall be off. The unit shall cycle occupied mode operation to satisfy the unoccupied space temperature setpoint. The FC-1 fan shall cycle and the heating coil control valve shall modulate to maintain unoccupied space temperature setpoint.

F. Safety Controls:

1. Shut down units whenever the building fire alarm is activated. Restart units when the alarm signal is cleared.

3.8 UNIT VENTILATORS

A. Points List:

Point I.D.	Description	Type	Remarks
UV	Fan Start/Stop	DO	
UV	Fan Status	AI	Current transmitter
UV	Supply Air Temperature	AI	
UV	Outdoor Air Damper	DO	
UV	Face and Bypass Damper	DO	Two position
UV	Heating Coil Control Valve	AO	
UV	Space Temperature Sensor	AI	
UV	Space Temperature Setpoint	AI	
UV	UV Current Transmitters	AI	Multiple current transmitters, on each electrical power leg, for trending total electrical usage

B. The unit ventilator shall operate in either occupied or unoccupied mode as scheduled.

C. During occupied mode the fan shall operate continuously, the outside air damper shall be open, the coil control valve shall open and the face & bypass dampers shall modulate to maintain the discharge air temperature setpoint to satisfy the space temperature setpoint.

D. During unoccupied mode the fan shall be off, the outside air damper shall be closed and the coil control valve shall be closed. The unit shall cycle occupied mode operation to satisfy the unoccupied space temperature setpoint.

E. Safety Controls:

1. Shut down unit ventilator and close outdoor air damper whenever the building fire alarm is activated. Restart units when the alarm signal is cleared.

3.9 OVERHEAD DOOR HEATERS

A. Points List:

Point ID	Description	Type	Remarks
ODH	Fan Start/Stop	DO	
ODH	Discharge Air Temperature	AI	
ODH	Discharge Air Temperature setpoint	AO	
ODH	Coil Control Valve	AO	
ODH	Overhead Door Open Signal	DI	
ODH	Outside Air Temperature Enable/Disable		Operator manual setting
ODH	Fan Time Delay ON After Door Open Signal		Operator manual setting
ODH	Fan Time Delay OFF After Door Closed		Operator manual setting
ODH	ODH Current Transmitters	AI	Multiple current transmitters, on each electrical power leg, for trending total electrical usage

A. Whenever the outside air temperature is below the operator manual setting and the door signal is open, the fan shall start and the coil control valve shall modulate to maintain the discharge air temperature setpoint. When the door signals closed, the fan shall stop and the coil control valve shall close. Provide settings for fan time delay when door opens and continued operation time delay when door is closed.

3.10 CABINET UNIT HEATERS/UNIT HEATERS

A. Points List:

Point ID	Description	Type	Remarks
CUH/UH	Fan Start/Stop	DO	
CUH/UH	Fan Status	AI	Current transmitter
CUH/UH	Coil Control Valve	DO	Two position
CUH/UH	Space Temperature Sensor	AI	Unit mounted in return air path if not shown on drawings
CUH/UH	Space Temperature Setpoint	AI	
CUH/UH	CUH/UH Current Transmitters	AI	Multiple current transmitters, on each electrical power leg, for trending total electrical usage

B. Units shall operate in either occupied or unoccupied mode as scheduled.

C. The fan and coil control valve shall cycle to maintain space occupied and unoccupied space temperature setpoint.

3.11 EXHAUST FANS

A. Points List:

Point ID	Description	Type	Remarks
EF	Fan Start/Stop	DO	
EF	Fan Status	AI	Current transmitter
EF	Damper	DO	Curb mounted
EF	Damper End Switch	DI	
EF-3/4/6/14	Exhaust Fan Button	DI	EXHAUST FAN on push button wall plate
GRV-2	Damper Open/Close	DO	
GRV-2	Damper End Switch	DI	
EF-1	Damper Open/Close	DO	EF and OSA
EF-1	Damper End Switch	DI	EF and OSA
EF-15	Fan Airflow Switch	DI	
EF-6	Space Temperature Sensor	AI	
EF-6	Space Temperature Setpoint	AI	
EF-17	Fan Speed	AI	
EF-17	Exhaust Fan Energy Output from Variable Frequency Drive	AI	
AIR COMPRESS OR	Air Compressor Status	DI	Current sensor
EF	Current Transmitters	AI	Multiple current transmitters, on each electrical power leg, for trending total electrical usage
HOSE REEL FANS	Current Sensor	DI	Monitor fans for operation to reduce AHU-8 exhaust fan

B. The exhaust fans shall operate as scheduled and the associated damper shall open, and prove open via end switch, prior to fan start, otherwise the fans shall be off and the dampers closed. If end switch does not prove open an alarm shall be generated and the fan shall remain off.

1. EF-1 and OSA dampers shall open prior to fan start.

2. EF-3/4/6/14 in Lunch Rooms and Boiler Room shall operate from a wall push button switch. When the exhaust fan button is depressed, the fan shall run continuously for an operator defined interval (default - 60 min). Provide laminated nameplate on wall push button plate: EXHAUST FAN.

   a. EF-6 shall also operate to maintain space temperature setpoint whenever the space temperature exceeds the space temperature setpoint. EF-6 and GRV-2 dampers shall open prior to fan start.

3. EF-15 shall be scheduled to operate continuously. Provide a red warning light with audible alarm and lockable silence button within sight of the Maintenance service pit. The alarm shall activate whenever the airflow switch proves no airflow.

4. EF-17 shall vary airflow dependent on number of air compressors operating. Modulate fan to exhaust 2000 cfm for each air compressor operating, for a total of 6000 cfm. Coordinate VFD frequency settings with the air balance contractor. Add EF-17 to the reference document accessible through the controls system noting “STEPPED DESIGN AIRFLOW”, with airflow and associated frequency for each step.

3.12 FINNED TUBE RADIATION BELOW 2ND FLOOR

A. Points List:

Point I.D.	Description	Type	Remarks
FT-4	Finned Tube Control Valve Open/Close	DO	Two Position
Space	Space Temperature Sensor	AI	Multiple
Space	Space Temperature Setpoint	AI	

B. Provide settings for an average space temperature to drive the system, polling the respective space temperature sensors, and settings for any one of the space temperature sensors to drive the system.

C. Cycle the finned tube control valve to satisfy the space temperature setpoint.

3.13 PAINTBOOTH

A. Points List:

Point I.D.	Description	Type	Remarks
MAU	Makeup Air Fan Status	DI	Current sensor
MAU	Supply Air Temperature	AI	
EF	Paithbooth Fan Status	DI	Current sensor

B. Provide interconnecting control wiring and all necessary devices between the makeup air unit, exhaust fan and manufactuer's control panel. Set up system operation per manufacturer's instructions.

3.15 RADIANT FLOOR HEATING SYSTEM

C. Points List:

Point ID	Description	Type	Remarks
RZ	Pump Start/Stop	DO	
RZ	Pump Status	AI	Current transmitter
RZ	Mixing Valve	AO	
RZ	Supply Water Temperature	AI	
RZ	Return Water Temperature	AI	
RZ	Mixed Water Temperature	AI	
RZ	Slab Sensor	AI	
RZ	Slab Sensor Setpoint	AI	
RZ	Pump Current Transmitters	AI	Multiple current transmitters, on each electrical power leg, for trending total electrical usage

D. The pump shall cycle to maintain the respective slab sensor setpoint. The mixing valve shall modulate to maintain the radiant supply water temperature 98°F. Provide high and low slab temperature limit settings beyond which an alarm shall be generated.

E. There shall be no electronic devices within 18" of the Maintenance floor, or within the Maintenance Pits.

3.14 PRESSURE WAHER DRAFT INDUCER (DIF-1)

A. Provide wiring between pressure washer and draft inducer, and set up system operation per manufacturer's instructions. Draft inducer shall provide proof of flow prior to burner ignition.

3.15 STORAGE & MAINTENANCE WINDOW OPEN SIGNAL

A. The BAS shall monitor open/closed window positions in Storage and Maintenance clearstories. The windows open/close in groups – (10) groups in Storage clearstory and (5) groups in Maintenance clearstory. Provide a switch for one window in each group. BAS shall monitor, provide graphics screen representation of clearstory with window positions.

3.16 ELECTRICAL DEMAND MONITORING AND TRENDING
MEASUREMENT AND VERIFICATION PLAN

A. Trend electrical demand and voltage at electrical service, individual HVAC equipment current sensors, site lighting panels, interior lighting panels and gas meters.. Trending shall continue at 15 minute intervals for a minimum of one year. As a minimum throughout the first year, the contractor is responsible for a monthly all inclusive energy usage report indicating current month and previous months energy usage, as well as a Summary of Savings to Date report. Provide data equipment necessary for storage of a year's worth of trend data and reports, with each point trending at 15 minute intervals.

1. Trend domestic water usage through water meter for record.

B. Trending: Provide trending for the following categories:

1. Voltage at electrical service
2. Facility-wide electrical usage
3. Individual HVAC equipment electrical usage
   a. Space heating
   b. Pumps
   c. Fans
   d. Space Cooling
4. Site lighting electrical energy usage
5. Interior lighting electrical energy usage
   a. Conditioned Spaces
   b. Non-Conditioned Spaces
6. Natural gas usage
   a. Site Meter
   b. Boiler Service
7. Domestic water usage

C. Provide Trending of the following items for the above categories:

End Use	Usage	Monthly Total												Annual Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Gas Meter Serving Boilers - B-1, B-2, B-3, B-4	Total MMBtu													
Space Heating Total	Total MMBtu													
Electrical Distribution Total	Total kWh													
	Max kW													
Boiler B-1	Total kWh													
	Max kW													
Boiler B-2	Total kWh													
	Max kW													
Boiler B-3	Total kWh													
	Max kW													
Boiler B-4	Total kWh													
	Max kW													
Space Heating Total	Total kWh													
	Max kW													
Pump P-1	Total kWh													
	Max kW													
Pump P-2	Total kWh													
	Max kW													
Pump BP-1	Total kWh													
	Max kW													
Pump BP-2	Total kWh													
	Max kW													

End Use	Usage	Monthly Total												Annual Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Pump BP-3	Total kWh													
	Max kW													
Pump BP-4	Total kWh													
	Max kW													
Radiant System RZ-1	Total kWh													
	Max kW													
Radiant System RZ-2	Total kWh													
	Max kW													
Radiant System RZ-3	Total kWh													
	Max kW													
Radiant System RZ-4	Total kWh													
	Max kW													
Radiant System RZ-5	Total kWh													
	Max kW													
Radiant System RZ-6	Total kWh													
	Max kW													
Radiant System RZ-7	Total kWh													
	Max kW													
Radiant System RZ-8	Total kWh													
	Max kW													
Radiant System RZ-9	Total kWh													
	Max kW													
Radiant System RZ-10	Total kWh													
	Max kW													
Radiant System RZ-11	Total kWh													
	Max kW													
Radiant	Total													

End Use	Usage	Monthly Total												Annual Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
System RZ-12	kWh													
	Max kW													
Pumps Total	Total kWh													
	Max kW													
Exhaust Fan EF-1	Total kWh													
	Max kW													
Exhaust Fan EF-2	Total kWh													
	Max kW													
Exhaust Fan EF-3	Total kWh													
	Max kW													
Exhaust Fan EF-4	Total kWh													
	Max kW													
Exhaust Fan EF-5	Total kWh													
	Max kW													
Exhaust Fan EF-6	Total kWh													
	Max kW													
Exhaust Fan EF-7	Total kWh													
	Max kW													
Exhaust Fan EF-8	Total kWh													
	Max kW													
Exhaust Fan EF-9	Total kWh													
	Max kW													
Exhaust Fan EF-10	Total kWh													
	Max kW													
Exhaust Fan EF-11	Total kWh													
	Max kW													
Exhaust Fan EF-12	Total kWh													

End Use	Usage	Monthly Total												Annual Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
	Max kW													
Exhaust Fan EF-13	Total kWh													
	Max kW													
Exhaust Fan EF-14	Total kWh													
	Max kW													
Exhaust Fan EF-15	Total kWh													
	Max kW													
Exhaust Fan EF-16	Total kWh													
	Max kW													
Exhaust Fan EF-17	Total kWh													
	Max kW													
Unit Heater ODH-1	Total kWh													
	Max kW													
Unit Heater ODH-2	Total kWh													
	Max kW													
Unit Heater ODH-3	Total kWh													
	Max kW													
Unit Heater ODH-4	Total kWh													
	Max kW													
Unit Heater ODH-5	Total kWh													
	Max kW													
Unit Heater ODH-6	Total kWh													
	Max kW													
Unit Heater ODH-7	Total kWh													
	Max kW													
Unit Heater ODH-8	Total kWh													
	Max													

End Use	Usage	Monthly Total												Annual Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
	kW													
Unit Heater UH-1	Total kWh													
	Max kW													
Unit Heater UH-2	Total kWh													
	Max kW													
Unit Heater UH-3	Total kWh													
	Max kW													
Unit Heater UH-4	Total kWh													
	Max kW													
Unit Heater UH-5	Total kWh													
	Max kW													
Unit Heater UH-6	Total kWh													
	Max kW													
Unit Heater UH-7	Total kWh													
	Max kW													
Unit Heater UH-8	Total kWh													
	Max kW													
Unit Heater UH-9	Total kWh													
	Max kW													
Unit Heater UH-10	Total kWh													
	Max kW													
Unit Heater UH-11	Total kWh													
	Max kW													
Unit Heater UH-12	Total kWh													
	Max kW													
Unit Heater UH-13	Total kWh													
	Max kW													

End Use	Usage	Monthly Total												Annual Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Unit Heater UH-14	Total kWh													
	Max kW													
Unit Heater UH-15	Total kWh													
	Max kW													
Unit Heater UH-16	Total kWh													
	Max kW													
Unit Heater UH-17	Total kWh													
	Max kW													
Unit Heater UH-18	Total kWh													
	Max kW													
Unit Ventilator UV-1	Total kWh													
	Max kW													
Unit Ventilator UV-2	Total kWh													
	Max kW													
Cabinet Heater CUH-1	Total kWh													
	Max kW													
Cabinet Heater CUH-2	Total kWh													
	Max kW													
Cabinet Heater CUH-3	Total kWh													
	Max kW													
Cabinet Heater CUH-4	Total kWh													
	Max kW													
Cabinet Heater CUH-5	Total kWh													
	Max kW													
Cabinet Heater CUH-6	Total kWh													
	Max kW													
Cabinet	Total													

End Use	Usage	Monthly Total												Annual Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
Heater CUH-7	kWh													
	Max kW													
Cabinet Heater CUH-8	Total kWh													
	Max kW													
Cabinet Heater CUH-9	Total kWh													
	Max kW													
RTU-1 Supply Fan VFD	Total kWh													
	Max kW													
RTU-1 Exhaust Fan VFD	Total kWh													
	Max kW													
RTU-2 Supply Fan VFD	Total kWh													
	Max kW													
RTU-2 Exhaust Fan VFD	Total kWh													
	Max kW													
RTU-3 Supply Fan VFD	Total kWh													
	Max kW													
RTU-3 Exhaust Fan VFD	Total kWh													
	Max kW													
RTU-4 Supply Fan VFD	Total kWh													
	Max kW													
RTU-4 Exhaust Fan VFD	Total kWh													
	Max kW													
RTU-5 Supply Fan VFD	Total kWh													
	Max kW													
RTU-5 Exhaust Fan VFD	Total kWh													
	Max kW													
RTU-6 Supply Fan VFD	Total kWh													
	Max													

End Use	Usage	Monthly Total												Annual Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
	kW													
RTU-6 Exhaust Fan VFD	Total kWh													
	Max kW													
RTU-7 Supply Fan VFD	Total kWh													
	Max kW													
RTU-7 Exhaust Fan VFD	Total kWh													
	Max kW													
RTU-8 Supply Fan VFD	Total kWh													
	Max kW													
RTU-8 Exhaust Fan VFD	Total kWh													
	Max kW													
RTU-9 Supply Fan VFD	Total kWh													
	Max kW													
RTU-9 Exhaust Fan VFD	Total kWh													
	Max kW													
RTU-10 Supply Fan VFD	Total kWh													
	Max kW													
RTU-10 Exhaust Fan VFD	Total kWh													
	Max kW													
RTU-11 Supply Fan VFD	Total kWh													
	Max kW													
RTU-11 Exhaust Fan VFD	Total kWh													
	Max kW													
RTU-12 Supply Fan VFD	Total kWh													
	Max kW													
RTU-12 Exhaust Fan VFD	Total kWh													
	Max kW													

End Use	Usage	Monthly Total												Annual Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
RTU-13 Supply Fan VFD	Total kWh													
	Max kW													
RTU-13 Exhaust Fan VFD	Total kWh													
	Max kW													
RTU-14 Supply Fan VFD	Total kWh													
	Max kW													
RTU-14 Exhaust Fan VFD	Total kWh													
	Max kW													
RTU-15 Supply Fan VFD	Total kWh													
	Max kW													
RTU-15 Exhaust Fan VFD	Total kWh													
	Max kW													
Fans Total	Total kWh													
	Max kW													
RTU-1 (subtract VFD's)	Total kWh													
	Max kW													
RTU-2 (subtract VFD's)	Total kWh													
	Max kW													
RTU-3 (subtract VFD's)	Total kWh													
	Max kW													
RTU-4 (subtract VFD's)	Total kWh													
	Max kW													
RTU-5 (subtract VFD's)	Total kWh													
	Max kW													
RTU-6 (subtract VFD's)	Total kWh													
	Max kW													
RTU-7	Total													

End Use	Usage	Monthly Total												Annual Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
(subtract VFD's)	kWh													
	Max kW													
RTU-8 (subtract VFD's)	Total kWh													
	Max kW													
RTU-9 (subtract VFD's)	Total kWh													
	Max kW													
RTU-10 (subtract VFD's)	Total kWh													
	Max kW													
RTU-11 (subtract VFD's)	Total kWh													
	Max kW													
RTU-12 (subtract VFD's)	Total kWh													
	Max kW													
RTU-13 (subtract VFD's)	Total kWh													
	Max kW													
RTU-14 (subtract VFD's)	Total kWh													
	Max kW													
RTU-15 (subtract VFD's)	Total kWh													
	Max kW													
Split System AC-1	Total kWh													
	Max kW													
Split System ACCU-1	Total kWh													
	Max kW													
Split System AC-2	Total kWh													
	Max kW													
Split System ACCU-2	Total kWh													
	Max kW													
Split System AC-3	Total kWh													

End Use	Usage	Monthly Total												Annual Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
	Max kW													
Split System ACCU-3	Total kWh													
	Max kW													
Split System AC-4	Total kWh													
	Max kW													
Split System ACCU-4	Total kWh													
	Max kW													
Split System AC-5	Total kWh													
	Max kW													
Split System ACCU-5	Total kWh													
	Max kW													
Split System AC-6	Total kWh													
	Max kW													
Split System ACCU-6	Total kWh													
	Max kW													
Split System AC-7	Total kWh													
	Max kW													
Split System ACCU-7	Total kWh													
	Max kW													
Split System AC-8	Total kWh													
	Max kW													
Split System ACCU-8	Total kWh													
	Max kW													
Split System AC-9	Total kWh													
	Max kW													
Split System ACCU-9	Total kWh													
	Max													

End Use	Usage	Monthly Total												Annual Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
	kW													
Split System AC-10	Total kWh													
	Max kW													
Split System ACCU-10	Total kWh													
	Max kW													
Split System AC-11	Total kWh													
	Max kW													
Split System ACCU-11	Total kWh													
	Max kW													
Split System AC-12	Total kWh													
	Max kW													
Split System ACCU-12	Total kWh													
	Max kW													
Split System AC-13	Total kWh													
	Max kW													
Split System ACCU-13	Total kWh													
	Max kW													
Split System AC-14	Total kWh													
	Max kW													
Split System ACCU-14	Total kWh													
	Max kW													
Split System AC-15	Total kWh													
	Max kW													
Split System ACCU-15	Total kWh													
	Max kW													
Split System FC-1	Total kWh													
	Max kW													
Split System	Total													

End Use	Usage	Monthly Total												Annual Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
ACCU-16	kWh													
	Max kW													
Split System HPC-1/ACHP-1	Total kWh													
	Max kW													
Split System HPC-2/ACHP-2	Total kWh													
	Max kW													
Split System HPC-3/ACHP-3	Total kWh													
	Max kW													
Split System HPC-4/ACHP-4	Total kWh													
	Max kW													
Split System HPC-5/ACHP-5	Total kWh													
	Max kW													
Space Cooling Total	Total kWh													
	Max kW													
Lighting-conditioned	Total kWh													
	Max kW													
Lighting-unconditioned	Total kWh													
	Max kW													
Lighting-Site	Total kWh													
	Max kW													
Guard Booth	Total kWh													
	Max kW													
Balance of Site meter Consumption	Total kWh													
	Max kW													

End Use	Usage	Monthly Total												Annual Total
		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
- Electric														
Balance of Site meter Consumption - Gas	Total kWh													
	Max kW													

END OF SECTION 230993

SECTION 232113 HYDRONIC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes piping systems for hot water heating, make-up water for these systems, and condensate drain piping. Piping materials and equipment specified in this Section include pipes and fittings.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5.

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Including material and rated capacities for straight pipe and fittings.

1.3 QUALITY ASSURANCE SUBMITTALS

A. Welders' certificates certifying that welders comply meet the quality requirements specified in Quality Assurance below.

B. Certification of compliance with ASTM and ANSI manufacturing requirements for pipe and fittings

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: comply with the provisions of the following:

1. ASME B 31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.

2. ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualification" for qualifications for welding processes and operators.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. All piping and fittings shall be manufactured in the United States of American or Canada.

2.2 PIPE AND TUBING MATERIALS

A. General: Refer to Part 3 Article "PIPE APPLICATIONS" for identification of where the below materials are used.

B. Drawn Temper Copper Tubing: ASTM B 88, Type L.

C. Annealed Temper Copper Tubing: ASTM B 88, Type K.

D. Steel Pipe: ASTM A 53, Schedule 40, seamless, black steel pipe, plane ends.

2.3 FITTINGS

A. Cast-Iron Threaded Fittings: ANSI B16.4, Class 125, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.

B. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.

C. Steel Fittings: ASTM A 234, seamless or welded, for welded joints.

D. Wrought-Copper Fittings: ANSI B16.22, streamlined pattern.

E. Cast-Iron Threaded Flanges: ANSI B16.1, Class 125; raised ground face, bolt holes spot faced.

F. Cast Bronze Flanges: ANSI B16.24, Class 150; raised ground face, bolt holes spot faced.

G. Steel Flanges and Flanged Fittings: ANSI B16.5, including bolts, nuts, and gaskets of the following material group, end connection and facing:

1. Material Group: 1.1.
2. End Connections: Butt Welding.
3. Facings: Raised face.

H. Unions: ANSI B16.39 malleable-iron, Class 150, hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends. Threads shall conform to ANSI B1.20.1.

2.4 JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, 95-5 Tin-Antimony.

B. Brazing Filler Metals: AWS A5.8, Classification BAg 1 (Silver).

1. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.

C. Welding Materials: Comply, with Section II, Part C. ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

D. Gasket Material: thickness, material, and type suitable for fluid to be handled, and design temperatures and pressures.

2.5 PRE-INSULATED PIPING

A. Provide a complete HDPE jacketed system of factory pre-insulated steel piping, with carrier pipe as specified. Carrier pipe fittings shall be socket-welded.

B. Insulation shall be polyisocyanurate foam insulation bonded to both the jacketing and carrier pipe and either spray applied or high pressure injected with one shot into the annular space between carrier pipe

and jacket with a nominal thickness of 2-1/2”. Insulation shall be rigid, 85% closed cell foam insulation with not less than 2.4 pounds per cubic foot density, having a compressive strength of not less than 30 psi @ 75°F and a coefficient of thermal conductivity (K-Factor) not higher than 0.17 @ 75°F.

C. Jacketing material shall be extruded, black, high density polyethylene (HDPE), having a minimum wall thickness of 125 mils, and shall incorporate electric fusion, butt fusion, or extrusion welding at all HDPE fittings, joint closures, and other points of connection, creating a jacket that is seamless throughout the entire system.

D. Straight run joints shall be insulated and jacketed with an electric fusion pressure testable joint closure. Fittings shall be factory pre-fabricated, pre-insulated and jacketed with a one piece seamless molded HDPE fitting cover, a butt fusion welded, or an extrusion welded and mitered HDPE jacket.

PART 3 - EXECUTION

3.1 PIPE APPLICATIONS

A. Install Type L, drawn copper tubing with wrought copper fittings and solder joints for 2 inch and smaller, above ground, within building. Install Type K, annealed temper copper tubing for 2 inch and smaller without joints, below ground or within slabs.

B. Install steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2 inch and larger and pre-insulated piping.

3.2 PIPING INSTALLATIONS

A. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

B. Use fittings for all changes in direction and all branch connections.

C. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

D. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

E. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

F. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

G. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and 3/4" threaded shoulder nipple and cap.

H. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inch and larger shall be sheet metal.

I. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity.

J. Install piping at a uniform grade of 1 inch in 40 feet upward in the direction of flow.

K. Make reductions in pipe sizes using eccentric reducer fitting installed with the level side up.

L. Install branch connections to mains using Tee fittings in main with take-off out the bottom of the main, except for up-feed risers which shall have take-off out the top of the main line.

M. Install unions in pipes 2 inch and smaller, adjacent to each valve, at final connections each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

N. Install dielectric fittings to join dissimilar metals.

O. Install flanges on valves, apparatus, and equipment having 2-1/2 inch and larger connections.

P. Install flexible connectors at inlet and discharge connections to pumps (except inline pumps) and other vibration producing equipment.

Q. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, inline pump, and elsewhere as indicated. Install nipple and ball valve in blow down connection of strainers 2 inch and larger.

R. Anchor piping to ensure proper direction of expansion and contraction.

3.3 PIPE JOINT CONSTRUCTION

A. Soldered Joints: Comply with the procedures contained in the AWS “Soldering Manual.”

B. Brazed Joints: Comply with the procedures contained in the AWS “Brazing Manual.”

1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before brazing.

2. Fill the pipe and fittings during brazing, with an inert gas (ie., nitrogen or carbon dioxide) to prevent formation of scale.

3. Heat joints using oxy-acetylene torch. Heat to proper and uniform temperature.

C. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe fittings and valves as follows:

1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.

2. Align threads at point of assembly.

3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).

4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

a. Damaged Threads: Do not use pipe with threads which are corroded or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

D. Welded Joints: Comply with the requirement in ASME Code B31.9 - “Building Services Piping.”

E. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

3.4 PREINSULATED PIPING

A. Underground systems shall be buried in a trench not less than two feet deeper than the top of the pipe and not less than eighteen inches wider than the combined O.D. of all piping systems. Provide a minimum thickness of 24 inches of compacted backfill placed over the top of the pipe will meet H-20 highway loading.

B. Trench bottom shall have a minimum of 6” of sand, or manufacturer’s approved backfill. All field-cutting of the pipe shall be performed in accordance with the manufacturer’s installation instructions.

C. Perform carrier pipe hydrostatic pressure test per specifications.

D. Provide filed service by a certified manufacturer’s representative or field service technician. The technician will be available at the job as required to ensure the contractor understands and has interpreted the installation instructions with respect to unloading, storing and handling of pipe, pipe installation, pressure testing, field joint insulation, leak detection connection, and backfilling technique.

3.5 FIELD QUALITY CONTROL

A. Preparation for testing: Prepare hydronic piping in accordance with ASME B 31.9 and as follows:

1. Leave joints including welds uninsulated and exposed for examination during the test.

2. Provide temporary restraints for expansion joints which cannot sustain the reactions due to test pressure. If temporary restraints are not practical, isolate expansion joints from testing.

3. Flush system with clean water. Clean strainers.

4. Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested.

5. Install relief valve set at a pressure no more than 1/3 higher than the test pressure, to protect against damage by expansion of liquid or other source of overpressure during the test.

B. Testing: Test hydronic piping as follows:

1. Use ambient temperature water as the testing medium, except where there is a risk of damage due to freezing. Another liquid may be used if it is safe for workmen and compatible with the piping system components.

2. Use vents installed at high points in the system to release trapped air while filling the system. Use drains installed at low points for complete removal of the that liquid.

3. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low pressure filling lines are disconnected.

4. Subject piping system to a hydrostatic test pressure which at every point in the system is not less than 1.5 times the design pressure. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in the system under test. Make a check to verify that the stress due to pressure at the bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength.

5. After the hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.

3.6 ADJUSTING AND CLEANING

A. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.

B. Mark calibrated name plates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

C. Chemical Treatment: Provide a water analysis prepared by the chemical treatment supplier to determine the type and level of chemicals required for prevention of scale and corrosion. Perform initial treatment after completion of system testing.

3.7 COMMISSIONING

A. Fill system and perform initial chemical treatment.

B. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.

C. Before operating the system perform these steps:

1. Open valves to full open position. Close coil bypass valves.

2. Remove and clean strainers.

3. Check pump for proper direction and correct improper wiring.

4. Set automatic fill valves for required system pressure.

5. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type). Following completion of start-up, close all air vent stop cocks.

6. Set temperature controls so all coils are calling for full flow.

7. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.

8. Lubricate motors and bearings.

END OF SECTION 232113

SECTION 232116 HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.1 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties and accessories, and installation instructions for each hydronic specialty and special duty valve specified.

2. Furnish flow and pressure drop curves for diverting fittings and calibrated-orifice balancing valves, based on manufacturer's testing.

1.2 QUALITY ASSURANCE SUBMITTALS

A. Certification of compliance with ASTM and ANSI manufacturing requirements for hydronic specialties.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For hydronic specialties and special duty valves to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: comply with the provisions of the following:

1. ASME B 31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.

2. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

1.5 EXTRA STOCK

A. Maintenance Stock: Furnish a sufficient quantity of chemical for initial system start-up and for preventative maintenance for one year from Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide hydronic piping system products from one of the following:

1. Calibrated-Orifice, Balancing Valve:

a. Bell & Gossett ITT; Fluid Handling Div.
b. Taco, Inc.
c. Tour & Andersson

2. Safety Relief Valves:

   a. Amtrol, Inc.
   b. Bell & Gossett ITT; Fluid Handling Div.
   c. Spirax Sarco.

3. Pressure Reducing Valves:

   a. Armstrong Pumps, Inc.
   b. Bell & Gossett ITT; Fluid Handling Div.
   c. Taco, Inc.

4. Air Vents (manual and automatic):

   a. Bell & Gossett ITT; Fluid Handling Div.
   b. Hoffman Specialty ITT; Fluid Handling Div.
   c. Spirax Sarco.

5. Air Separators:

   a. Armstrong Pumps, Inc.
   b. Bell & Gossett ITT; Fluid Handling Div.
   c. Taco, Inc.

6. Expansion Tanks:

   a. Armstrong Pumps, Inc.
   b. Bell & Gossett ITT; Fluid Handling Div.
   c. Taco, Inc.

7. Diaphragm-Type Expansion Tanks:

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett ITT; Fluid Handling Div.

8. Pump Suction Diffusers:

   a. Armstrong Pumps, Inc.
   b. Bell & Gossett ITT; Fluid Handling Div.
   c. Taco, Inc.

9. Pump Discharge Valve (Triple Duty Valve):

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Taco, Inc.

10. Chemical Feeder:

    a. Culligan USA.
    b. Vulcan Laboratories, Subsidiary of Clow Corp.
    c. York-Shipley, Inc.

11. Diverting Fittings:

    a. Armstrong Pumps, Inc.
    b. Bell & Gossett ITT; Fluid Handling Div.
    c. Taco, Inc.

12. Y-Pattern Strainers:

a. Hoffman Specialty ITT; Fluid Handling Div.
b. Spirax Sarco.
c. Victaulic Co. of America.

2.2 HYDRONIC SPECIALTIES

A. Calibrated-Orifice, Balancing Valve: Bronze body, 125 psig CWP, 250°F maximum operating temperature, with brass or stainless steel ball, PTFE seat, and calibrated orifice. Provide threaded or socket ends, integral pressure gage seals for differential pressure reading, and lever handle with memory stop. Valves shall be equal size to the supply and return piping line size.

B. Manual Air Vent: bronze body and nonferrous internal parts; 150 psig working pressure, 225°F operating temperature; manually operated with screwdriver or thumbscrew; and having 1/8 inch discharge connection and 1/2 inch inlet connection.

C. Automatic Air Vent: designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150 psig working pressure, 240°F operating temperature; and having 1/4 inch discharge connection and 1/2 inch inlet connection.

D. Diaphragm-Type Expansion Tanks: size and number as indicated; full acceptance type; construct of welded carbon steel for 125 psig working pressure, 375°F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity, by means of a flexible diaphragm securely sealed into tank. Provide taps for pressure gage and air charging fitting, and drain fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Tank, with taps and supports, shall be constructed, tested, and labeled in accordance with ASME Pressure Vessel Code, Section VIII, Division 1.

E. Air separator: welded black steel; ASME constructed and labeled for minimum 125 psig water working pressure and 375°F operating temperature; perforated stainless steel air collector tube tangential inlet and outlet connections; screwed connections up to and including 2" NPS; flanged connections for 1-1/2" NPS and above; threaded blowdown connection; sized as indicated for full system flow capacity.

F. Pump Suction Diffusers: cast-iron body, with threaded connections for 2 inch and smaller, flanged connections for 2-1/2 inch and larger; 175 psig working pressure, 300°F maximum operating temperature; and complete with the following features:

1. Inlet vanes with length 2-1/2 times pump suction diameter or greater.

2. Cylinder strainer with 3/16 inch diameter openings with total free area equal to or greater than 5 times cross-sectional area of pump suction, designed to withstand pressure differential equal to pump shutoff head.

3. Disposable fine mesh strainer to fit over cylinder strainer.

4. Permanent magnet, located in flow stream, removable for cleaning.

5. Adjustable foot support, designed to carry weight of suction piping.

6. Blowdown tapping in bottom; gage tapping in side.

G. Pump Suction Diffusers: cast-iron body, with threaded connections for 2 inch and smaller, grooved connections for 2-1/2 inch and larger; 300 psig working pressure, 230°F maximum operating temperature; and complete with the following features:

1. Inlet vanes with length 2-1/2 times pump section diameter or greater.

2. Cylinder strainer with 3/15 inch diameter openings, designed to withstand pressure differential equal to pump shutoff head.

3. Disposable fine mesh strainer to fit over cylinder strainer.

4. Permanent magnet, located in flow stream, removable for cleaning.

5. Adjustable foot support, designed to carry weight of suction piping.

6. Blowdown tapping in bottom; gage tapping in side.

H. Pump Discharge Valve, Triple-Duty Valve: Angle or straight pattern, 175-psig pressure rating, ductile-iron body, pump-discharge fitting; with drain plug ad bronze-fitted shutoff, balancing, and check valve features. Brass gage ports with integral check valve, and orifice for flow measurement.

I. Chemical Feeder: bypass type chemical feeders of 5 gallon capacity, welded steel construction; 125 psig working pressure; complete with fill funnel and inlet, outlet, and drain valves.

1. Chemicals shall be specially formulated to prevent accumulation of scale and corrosion in piping system and connected equipment, developed based on a water analysis of make-up water.

J. Diverting Fittings: cast iron body with threaded ends, or wrought copper with solder ends; 125 psig working pressure, 250EF maximum operating temperature. Indicate flow direction on fitting.

K. Y-Pattern Strainers: 125 psig working pressure cast-iron body (ASTM A 126, Class B), flanged ends for 2-1/2 inch and larger, threaded connections for 2 inch and smaller, bolted cover, perforated Type 304 stainless steel basket, and bottom drain connection.

L. Heat Trace: Furnish and install a complete UL listed system of heat cable and components for freeze protection of AHU-7 and AHU-10 rooftop drain piping. Heat trace system shall comply with ANSI/IEEE Standard 515 – 1989 and IEEE P515.1. Provide self-regulating cable, 16 AWG nickel plated copper bus wire, dielectric insulation, tinned copper metallic braid and jacket. 120V – nominal 3 watts/ft at 50°F. Provide power kit, termination kit and line sensing thermostat Install per manufacturer's written instructions.

PART 3 - EXECUTION

3.1 HYDRONIC SPECIALTIES INSTALLATION

A. Install calibrated-orifice balance valve where indicated on the Drawings.

B. Install manual air vents at high points in the system, at heat transfer coils, and elsewhere as required for system air venting.

C. Install automatic air vents at high points in the system, heat transfer coils, and elsewhere as required for system air venting.

D. Install dip tube fittings in boiler outlet. Run piping to expansion tank with 1/4 inch per foot (2 percent) upward slope towards tank. Connect boiler outlet piping.

E. Install inline air separators in pump suction lines. Run piping to expansion tank with 1/4 inch per foot (2 percent) upward slope towards tank. Install drain valve on units 2 inch and larger.

F. Install combination air separator in pump suction lines. Run piping to expansion tank with 1/4 inch per foot (2 percent) upward slope towards tank. Install blowdown piping with gate valve; extend to nearest drain.

G. Install pump suction diffusers on pump suction inlet, adjust foot support to carry weight of suction piping. Install nipple and ball valve in blowdown connection.

H. Install pump discharge valves in horizontal or vertical position with stem in upward position. Allow clearance above stem for check mechanism removal.

I. Install shot-type chemical feeders in each hydronic system where indicated; in upright position with top of funnel not more than 48 inches above floor. Install feeder in bypass line, off main using globe valves on each side of feeder and in the main between bypass connections. Pipe drain, with ball valve, to nearest equipment drain.

J. Install diaphragm-type expansion tanks on floor as indicated. Vent and purge air from hydronic system, charge tank with proper air charge to suit system design requirements.

END OF SECTION 232116

SECTION 232119 GLYCOL INJECTION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes glycol injection system and glycol fluid.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-3(k).

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include manufacturer's descriptive literature, operating instructions, and maintenance and repair data.

C. Sample Report: Submit sample report indicating the chemical composition including but not limited to the following:

1. Percent of glycol to water solution.
2. Freeze protection temperature.
3. pH level.
4. Specific conductance.
5. Chloride and Sulfide content.
6. Suspended matter.

1.3 INFORMATION SUBMITTALS

A. Product certificates signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and products' compliance with specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glycol injection system to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For glycol injection system specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 QUALITY ASSURANCE

A. After the system has been filled with the glycol solution, and circulated for a minimum of 7 days, the contractor shall obtain a glycol sampling kit from the supplier. The appropriate sample or samples shall be taken and forwarded to the supplier's laboratory where the samples shall be tested and analyzed.

PART 2 - PRODUCTS

2.1 PACKAGED GLYCOL INJECTION UNIT

A. Provide a packaged fully piped and wired glycol feed system for the addition of glycol solution to the closed loop piping system. The system automatically maintains pressure in the loop by adding glycol solution to make up for losses which occur due to leakage. Glycol addition is controlled by a pressure switch with adjustable low and high setpoints. When the pressure in the loop reaches the low setpoint the pump begins to feed glycol into the system until the high pressure setpoint is achieved and stop the pump.

1. Tank: 50 gallon polyethylene tank mounted in a steel frame.

2. Pump: Bronze rotary gear pump (1.3 gpm at 100 psi).
   a. Ball valve and strainer on suction.
   b. Ball valve, check valve, pressure gauge and brass relief with return to tank tubing on discharge.

3. Float switch: Low level alarm and pump shut off float switch.

4. Control Panel: NEMA 4X
   a. Hand-Off-Auto selector switch for pump motor.
   b. Pump ON indicator light.
   c. Low tank level indicator light.
   d. Audible alarm with silence button.
   e. Power cord with plug, 115V/1Phz.

5. Basis of design manufacturer: Neptune model G-50-1A.

2.2 FLUIDS

A. Glycol shall be of the propylene type with inhibitors manufactured especially for heating and cooling systems. Glycol shall be colored type “DowFrost” as manufactured by the Dow Chemical Co., “Norkool” as manufactured by Union Carbide Co. or approved equal.

B. Water shall consist of the following options:

1. Glycol manufacturer’s premixed solution.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer’s installation instructions and recommendations.

B. Glycol shall not be injected until the piping system(s) have been tested, cleaned and flushed.

C. The contractor shall calculate and supply the volume of fluid required by the system(s) for the percentage of glycol to water specified.

END OF SECTION 232119

SECTION 232123 HVAC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following types of HVAC pumps:

1. Inline booster pumps.
2. Inline circulators.
3. Vertical, inline pumps.
4. Base-mounted, separately coupled, end-suction pumps.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-3(k).

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. Product Data: For each type of product.

1. Include certified performance curves of selected models indicating selected pump's operating point, weights (shipping, installed, and operating), furnished specialties, and accessories.

C. Shop Drawings: Showing layout and connections for HVAC pumps. Include setting drawings with templates, and directions for installation of foundation bolts and other anchorages.

D. Wiring Diagrams: Detailing wiring for power, signal, and control systems, differentiating between manufacturer-installed wiring and field-installed wiring.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of pump to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For each type of pump specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 QUALITY ASSURANCE

A. Hydraulic Institute Compliance: Design, manufacture, and install HVAC pumps in accordance with "Hydraulic Institute Standards."

B. National Electrical Code Compliance: Provide components complying with NFPA 70 "National Electrical Code."

C. UL Compliance: Provide HVAC pumps which are listed and labeled by UL, and comply with UL Standard 778 “Motor Operated Water Pumps.”

D. NEMA Compliance: Provide electric motors and components that are listed and labeled NEMA.

E. Single Source Responsibility: Obtain HVAC pumps from a single manufacturer.

F. Design Criteria: The Drawings indicate sizes, profiles, connections, and dimensional requirements of HVAC pumps, and are based on the specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered, provided deviations in dimensions and profiles and efficiencies do not change the design concept or intended performance as judged by the Engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide products by one of the following:

1. Vertical Inline Pumps:

   a. Armstrong Pumps, Inc.
   b. Bell & Gossett, ITT.
   c. Taco, Inc.

2. Base-Mounted, Separately-Coupled, End-Suction Pumps:

   a. Armstrong Pumps, Inc.
   b. Bell & Gossett, ITT.
   c. Taco, Inc.

2.2 PUMPS, GENERAL

A. Pumps and Circulators: Factory-assembled and factory-tested. Fabricate casings to allow removal and replacement of impellers without necessity of disconnecting piping. Type, sizes, and capacities shall be as indicated.

B. Preparation for Shipping: After assembly and testing, clean flanges and exposed machined metal surfaces and treat with an anticorrosion compound. Protect flanges, pipe openings, and nozzles.

C. Motors: Conform to NEMA Standard MG-1, general purpose, continuous duty, Design B, except Design C where required for high starting torque; single, multiple, or variable speed with type of enclosure and electrical characteristics as indicated; have built-in thermal-overload protection, and grease-lubricated ball bearings. Select motors that are non-overloading within the full range of the pump performance curve.

D. Efficiency: “Energy Efficient” motors shall have a minimum efficiency as indicated in accordance with IEEE Standard 112, Test Method B. If efficiency is not specified, motor shall have a higher efficiency than the “average standard industry motors,” in accordance with IEEE Standard 112, Test Method B.

E. Motor Frame: NEMA Standard 48 or 54; use pump manufacturer’s standard.

F. Apply factory finish paint to assembled, tested units prior to shipping.

2.3 VERTICAL INLINE PUMPS

A. General Description: Pumps shall be centrifugal, close-coupled, single-stage, bronze-fitted, radially split case design, with mechanical seals, and rated for 175 psig working pressure and 225°F continuous water temperature.

B. Casings Construction: Cast iron, with threaded companion flanges for piping connections smaller than 2-1/2 inches, and threaded gage tappings at inlet and outlet connections.

C. Impeller Construction: Statically and dynamically balanced, closed, overhung, single-suction, cast bronze, conforming to ASTM B 584, and keyed to shaft.

D. Wear Rings: Removable, bronze.

E. Pump Shaft and Sleeve: Ground and polished steel shaft, with bronze sleeve and integral thrust bearing. Provide flinger on motor shaft between motor and seals to prevent liquid that leaks past pump seals from entering the motor bearings.

F. Seals: Mechanical Seals consisting of carbon steel rotating ring, stainless steel spring, ceramic seat, and flexible bellows and gasket.

G. Seals: Stuffing box having a minimum of 4 rings of graphite impregnated braided yarn with a bronze lantern ring between center 2 graphite rings and a bronze packing gland.

H. Motor: Direct-mounted to pump casing; with lifting and supporting lugs in top of motor enclosure.

2.4 BASE-MOUNTED, SEPARATELY-COUPLED, END-SUCTION PUMPS

A. General Description: Pumps shall be base-mounted, centrifugal, separately-coupled, end-suction, single-stage, bronze-fitted, radially split case design, and rated for 175 psig working pressure and 225°F continuous water temperature.

B. Casings Construction: Cast iron, with flanged piping connections, and threaded gage tappings at inlet and outlet flange connections.

C. Impeller Construction: Statically and dynamically balanced, closed, overhung, single-suction, fabricated from cast bronze conforming to ASTM B 584, keyed to shaft and secured by a locking cap screw.

D. Wear Rings: Replaceable, bronze.

E. Pump Shaft and Sleeve Bearings: Steel shaft, with bronze sleeve.

F. Seals: Mechanical seals consisting of carbon steel rotating ring, stainless steel spring, ceramic seat, and flexible bellows and gasket.

G. Seals: Stuffing box consisting of a minimum of 4 rings of graphite impregnated braided yarn with a bronze lantern ring between center 2 graphite rings, and a bronze packing gland.

H. Pump Couplings: Flexible, capable of absorbing torsional vibration and shaft misalignment; complete with metal coupling guard.

I. Mounting Frame: Factory-welded frame and cross members, fabricated of steel channels and angles conforming to ASTM B 36. Fabricate for mounting pump casing, coupler guard, and motor. Grind welds smooth prior to application of factory finish. Motor mounting holes for field-installed motors shall be field-drilled.

J. Motor: Secured to mounting frame with adjustable alignment on mounting frame.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment foundations, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of HVAC pumps.

B. Examine rough-in for piping systems to verify actual locations of piping connections prior to installation.

C. Examine equipment foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 EQUIPMENT BASES

A. Construct concrete equipment pads as follows:

1. Form concrete pads using steel channels conforming to ASTM A 36, size and location as indicated. Miter and weld corner and provide cross bracing. Anchor or key to floor slab.

2. Form concrete pads using framing lumber with form release compounds. Chamfer top edge and corners of pad.

3. Install reinforcing bars, tied to frame, and place anchor bolts and sleeves using manufacturer's installation template.

4. Place concrete and allow to cure before installation of pumps. Use Portland Cement conforming to ASTM C150, 4,000 psi compressive strength, and normal weight aggregate.

5. Clean exposed steel form and apply 2 coats of rust-preventative metal primer and 2 coats of exterior, gloss, alkyd enamel. Color shall be as selected by the Architect.

3.3 INSTALLATION

A. General: Comply with the manufacturer's written installation and alignment instructions.

B. Install pumps in locations and arranged to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.

C. Support pumps and piping separately so that the weight of the piping system does not rest on the pump.

D. Suspend inline pumps using all thread hanger rod and vibration isolation hangers of sufficient size to support the weight of the pump independent from the piping system.

E. Set base-mounted pumps on concrete foundation. Disconnect coupling halves before setting. Do not reconnect couplings until the alignment operations have been completed.

1. Support pump base plate on rectangular metal blocks and shims, or on metal wedges having a small taper, at points near the foundation bolts to provide a gap of 3/4 to 1-1/2 inches between the pump base and the foundation for grouting.

2. Adjust the metal supports or wedges until the shafts of the pump and driver are level. Check the coupling faces and suction and discharge flanges of the pump to verify that they are level and plumb.

3.4 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting on foundations, after grout has been set and foundations bolts have been tightened, and after piping connections have been made.

1. Adjust alignment of pump and motor shafts for angular and parallel alignment by one of the two methods specified in the Hydraulic Institute “Centrifugal Pumps - Instructions for Installation, Operation and Maintenance.”

B. After alignment is correct, tighten the foundation bolts evenly, but not too firmly. Fill the base plate completely with non-shrink, nonmetallic grout, with metal blocks and shims or wedges in place. After grout has cured, fully tighten foundation bolts.

1. Alignment tolerances shall meet manufacturer’s recommendations.

3.5 CONNECTIONS

A. General: Install valves that are same size as the piping connecting the pump.

B. Install suction and discharge pipe sizes equal to or greater than the diameter of the pump nozzles.

C. Install a non-slam check valve on the discharge side of inline pumps.

D. Install a triple-duty valve on the discharge side of base-mounted, end-suction pumps.

E. Install a ball or butterfly valve and strainer on the suction side of inline pumps.

F. Install a pump suction diffuser and ball or butterfly valve on the suction side of base-mounted, end-suction pumps.

G. Install flexible connectors on the suction and discharge side of each base-mounted pump. Install flexible connectors between the pump casing and the discharge valves, and upstream from the pump suction diffuser.

H. Install pressure gages on the suction and discharge of each pump at the integral pressure gage tappings provided.

I. Install temperature and pressure gage connector plugs in suction and discharge piping around pump. Temperature and pressure gage connector plugs are specified in other Sections

J. Electrical wiring and connections are specified in other Sections.

K. Control wiring and connections are specified in other Sections.

3.6 FIELD QUALITY CONTROL

A. Check suction lines connections for tightness to avoid drawing air into the pump.

3.7 COMMISSIONING

A. Final Checks Before Start-Up: Perform the following preventative maintenance operations and checks before start-up:

1. Lubricate oil-lubricated bearings.

2. Remove grease-lubricated bearing covers and flush the bearings with kerosene and thoroughly clean. Fill with new lubricant in accordance with the manufacturer=s recommendations.

3. Disconnect coupling and check motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.

4. Check that pump is free to rotate by hand. For pumps handling hot liquids, pump shall be free to rotate with the pump hot and cold. If the pump is bound or even drags slightly, do not operate the pump until the cause of the trouble is determined and corrected.

B. Starting procedure for pumps with shutoff power not exceeding the safe motor power:

1. Prime the pump, opening the suction valve, closing the drains, and prepare the pump for operation.

2. Open the valve in the cooling water supply to the bearings, where applicable.

3. Open the cooling water supply valve if the stuffing boxes are water-cooled.

4. Open the sealing liquid supply valve if the pump is so fitted.

5. Open the warm-up valve of a pump handling hot liquids if the pump is not normally kept at operating temperature.

6. Open the recirculating line valve if the pump should not be operated against dead shutoff.

7. Start the motor.

8. Open the discharge valve slowly.

9. Observe the leakage from the stuffing boxes and adjust the sealing liquid valve for proper flow to ensure the lubrication of the packing. Do not tighten the gland immediately, but let the packing run in before reducing the leakage through the stuffing boxes.

10. Check the general mechanical operation of the pump and motor.

11. Close the recirculating line valve once there is sufficient flow through the pump to prevent overheating.

C. If the pump is to be started against a closed check valve with the discharge ball or butterfly valve open, the steps are the same, except that the discharge ball or butterfly valve is opened some time before the motor is started.

D. Detailed requirements for “Testing, Adjusting, and Balancing” are covered in other Sections.

END OF SECTION 232123

SECTION 232300 REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes refrigerant piping used for air conditioning applications. This Section includes:

1. Pipes, tubing, fittings, and specialties.
2. Special duty valves.
3. Refrigerants.

B. Products installed but not furnished under this Section include pre-charged tubing, refrigerant specialties, and refrigerant accessories furnished as an integral part of or separately with packaged air conditioning equipment.

C. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-3(k).

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For the following products:

1. Each type valve specified.
2. Each type refrigerant piping specialty specified.

C. Shop Drawings: Showing layout of refrigerant piping, specialties, and fittings including, but not necessarily limited to, pipe and tube sizes, valve arrangements and locations, slopes of horizontal runs, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and proximate to equipment.

1.3 QUALITY ASSURANCE SUBMITTALS

A. Brazer's Certificates signed by Contractor certifying that brazers comply with requirements specified under "Quality Assurance" below.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For refrigerant valves and piping specialties to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 QUALITY ASSURANCE

A. Qualify brazing processes and brazing operators in accordance with ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

B. Regulatory Requirements: Comply with provisions of the following codes:

1. ANSI B31.5: ASME Code for Pressure Piping - Refrigerant Piping.
2. ANSI/ASHRAE Standard 15: Safety Code for Mechanical Refrigeration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Refrigerant Valves and Specialties:

a. Alco Controls Div, Emerson Electric.
b. Danfoss Electronics, Inc.
c. Sporlan Valve Company.

2.2 PIPE AND TUBING MATERIALS

A. Copper Tubing: ASTM B 280, Type ACR, hard-drawn straight lengths, and soft-annealed coils, seamless copper tubing. Tubing shall be factory cleaned, ready for installation, and have ends capped to protect cleanliness of pipe interiors prior to shipping.

B. Copper Tubing: ASTM B 88, Type L, hard-drawn straight lengths, and soft-annealed coils, seamless copper tubing.

2.3 FITTINGS

A. Wrought-Copper Fittings: ANSI B16.22, streamlined pattern.

2.4 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (Silver).

2.5 VALVES

A. General: Complete valve assembly shall be UL-listed and designed to conform to ARI 760.

B. Globe: 450 psig maximum operating pressure, 275°F maximum operating temperature; cast bronze body, with cast bronze or forged brass wing cap and bolted bonnet; replaceable resilient seat disc; plated steel stem. Valve shall be capable of being repacked under pressure. Valve shall be straight through or angle pattern, with solder-end connections.

C. Check Valves - Smaller Than 7/8 inch: 500 psig maximum operating pressure, 300°F maximum operating temperature; cast brass body, with removable piston, Teflon seat, and stainless steel spring; straight through globe design. Valve shall be straight through pattern, with solder-end connections.

D. Check Valves - 7/8 inch and Larger: 450 psig maximum operating pressure, 300°F maximum operating temperature; cast bronze body, with cast bronze or forged brass bolted bonnet; floating piston with mechanically retained Teflon seat disc. Valve shall be straight through or angle pattern, with solder-end connections.

E. Solenoid Valves: 250°F temperature rating, 400 psig working pressure; forged brass, with Teflon valve seat, two-way straight through pattern, and solder end connections. Provide manual operator to

open valve. Furnish complete with NEMA 1 solenoid enclosure with 1/2 inch conduit adapter, and 24 volt, 60 Hz. normally closed holding coil.

F. Evaporator Pressure Regulating Valves: pilot-operated, forged brass or cast bronze; complete with pilot operator, stainless steel bottom spring, pressure gage tappings, 24 volts DC, 50/60 Hz, standard coil; and wrought copper fittings for solder end connections.

G. Thermal Expansion Valves: thermostatic adjustable, modulating type; size as required for specific evaporator requirements, and factory set for proper evaporator superheat requirements. Valves shall have copper fittings for solder end connections; complete with sensing bulb, a distributor having a side connection for hot gas bypass line, and an external equalizer line.

H. Hot Gas Bypass Valve: adjustable type, sized to provide capacity reduction beyond the last step of compressor unloading; and wrought copper fittings for solder end connections.

2.6 REFRIGERANT PIPING SPECIALTIES

A. General: Complete refrigerant piping specialty assembly shall be UL-listed and designed to conform to ARI 760.

B. Strainers: 500 psig maximum working pressure; forged brass body with monel 80-mesh screen, and screwed cleanout plug; Y-pattern, with solder end connections.

C. Moisture/liquid Indicators: 500 psig maximum operation pressure, 200°F maximum operating temperature; forged brass body, with replaceable polished optical viewing window, and solder end connections.

D. Filter-driers: 500 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel capscrews, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter-drier core kit, including gaskets, as follows:

1. Standard capacity desiccant sieves to provide micronic filtration.
2. High capacity desiccant sieves to provide micronic filtration and extra drying capacity.

E. Suction Line Filter-Drier: 350 psig maximum operation pressure, 225°F maximum operating temperature; steel shell, and wrought copper fittings for solder end connections. Permanent filter element shall be molded felt core surrounded by a desiccant. for removal of acids and moisture for refrigerant vapor.

F. Suction Line Filters: 500 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel capscrews, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter core kit, including gaskets, as follows:

G. Flanged Unions: 400 psig maximum working pressure, 330°F maximum operating temperature; two brass tailpiece adapters for solder end connections to copper tubing; flanges for 7/8 inch through 1-5/8 inch unions shall be forged steel, and for 2-1/8 inch through 3-1/8 inch shall be ductile iron; four plated steel bolts, with silicon bronze nuts and fiber gasket. Flanges and bolts shall have factory-applied rust-resistant coating.

H. Flexible Connectors: 500 psig maximum operating pressure; seamless tin bronze or stainless steel core, high tensile bronze braid covering, solder connections, and synthetic covering; dehydrated, pressure tested, minimum 7 inch in length.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine rough-in for refrigerant piping systems to verify actual locations of piping connections prior to installation.

3.2 PIPE APPLICATIONS

A. Use Type L, or Type ACR drawn copper tubing with wrought copper fittings and brazed joints above ground, within building. Use Type K, annealed temper copper tubing for 2 inch and smaller without joints, below ground and within slabs. Mechanical fittings (crimp or flair) are not permitted.

1. Install annealed temper tubing in pipe duct. Vent pipe duct to the outside.

B. If other than Type ACR tubing is used, clean and protect inside of tubing as specified in Article "CLEANING" below.

3.3 PIPING INSTALLATIONS

A. General: Install refrigerant piping in accordance with ASHRAE Standard 15 – "The Safety Code for Mechanical Refrigeration."

B. Install piping in as short and direct arrangement as possible to minimize pressure drop.

C. Install piping for minimum number of joints using as few elbows and other fitting as possible.

D. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.

E. Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full thickness insulation.

F. Insulate suction lines. Liquid line are not required to be insulated, except where they are installed adjacent and clamped to suction lines, where both liquid and suction lines shall be insulated as a unit.

1. Do not install insulation until system testing has been completed and all leaks have been eliminated.

G. Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.

H. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

I. Slope refrigerant piping as follows:

1. Install horizontal hot gas discharge piping with 1/2" per 10 feet downward slope away from the compressor.

2. Install horizontal suction lines with 1/2 inch per 10 feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.

3. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.

4. Liquid lines may be install level.

J. Use fittings for all changes in direction and all branch connections.

K. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

L. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

M. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

N. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

O. Locate groups of piper parallel to each other, spaced to permit applying insulation and servicing of valves.

P. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inch and larger shall be sheet metal.

Q. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity. Refer to Division 7 for special sealers and materials.

R. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.

S. Install strainers immediately ahead of each expansion valve, solenoid valve, hot gas bypass valve, compressor suction valve, and as required to protect refrigerant piping system components.

T. Install moisture/liquid indicators in liquid lines between filter/driers and thermostatic expansion valves and in liquid line to receiver.

1. Install moisture/liquid indicators in lines larger than 2-1/8 inch OD, using a bypass line.

U. Install unions to allow removal of solenoid valves, pressure regulating valves, expansion valves, and at connections to compressors and evaporators.

V. Install flexible connectors at the inlet and discharge connection of compressors.

3.4 HANGERS AND SUPPORTS

A. General: Hanger, supports, and anchors are specified in other Sections. Conform to the table below for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.

2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.

3. Pipe rollers complete supports for multiple horizontal runs, 20 feet or longer supported by a trapeze.

4. Spring hangers to support vertical runs.

C. Install hangers with the following minimum rod sizes and maximum spacing:

Nom. Pipe Size	Max. Span-Ft	Min. Rod Size - Inches
1	7	3/8
1-1/2	9	3/8
2	10	3/8
3	12	1/2
3-1/2	13	1/2
4	14	5/8
5	16	5/8
6	17	3/4
8	19	7/8
10	22	7/8
12	23	7/8

D. Support vertical runs at each floor.

3.5 PIPE JOINT CONSTRUCTION

A. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

1. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.

2. CAUTION: When solenoid valves are being installed, remove the coil to prevent damage. When sight glasses are being installed, remove the glass. Remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties before brazing. Do no apply heat near the bulb of the expansion valve.

B. Fill the pipe and fittings during brazing, with an inert gas (ie., nitrogen or carbon dioxide) to prevent formation of scale.

C. Heat joints using oxy-acetylene torch. Heat to proper and uniform brazing temperature.

3.6 VALVE INSTALLATIONS

A. General: Install refrigerant valves where indicated, and in accordance with manufacturer's instructions.

B. Install globe valves on each side of strainers and driers, in liquid and suction lines at evaporators, and elsewhere as indicated.

C. Install a full sized, 3-valve bypass around each drier.

D. Install solenoid valves ahead of each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at the top.

1. Electrical wiring for solenoid valves is specified in Division 26. Coordinate electrical requirements and connections.

E. Thermostatic expansion valves may be mounted in any position, as close as possible to the evaporator.

1. Where refrigerant distributors are used, mount the distributor directly on the expansion valve outlet.

2. Install the valve in such a location so that the diaphragm case is warmer than the bulb.

3. Secure the bulb to a clean, straight, horizontal section of the suction line using two bulb straps. Do not mount bulb in a trap or at the bottom of the line.

4. Where external equalizer lines are required make the connection where it will clearly reflect the pressure existing in the suction line at the bulb location.

F. Install pressure regulating and relieving valves as required by ASHRAE Standard 15.

3.7 EQUIPMENT CONNECTIONS

A. The Drawings indicate the general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow servicing and maintenance.

3.8 FIELD QUALITY CONTROL

A. Inspect, test, and perform corrective action of refrigerant piping in accordance with ASME Code B31.5, Chapter VI.

B. Repair leaking joints using new materials, and retest for leaks.

3.9 CLEANING

A. Before installation of copper tubing other than Type ACR tubing, clean the tubing and fitting using following cleaning procedure:

1. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through the tubing by means of a wire or an electrician's tape.

2. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.

3. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.

4. Finally, draw a clean, dry, lintless cloth through the tube or pipe.

3.10 ADJUSTING AND CLEANING

A. Verify actual evaporator applications and operating conditions, and adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

B. Clean and inspect refrigerant piping systems.

C. Adjust controls and safeties. Replace damaged or malfunctioning controls and equipment with new materials and products.

3.11 COMMISSIONING

A. Charge system using the following procedure:

1. Install core in filter dryer after leak test but before evacuation.

2. Evacuate refrigerant system with vacuum pump; until temperature of 35°F is indicated on vacuum dehydration indicator.

3. During evacuation, apply heat to pockets, elbows, and low spots in piping.

4. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.

5. Break vacuum with refrigerant gas, allow pressure to build up to 2 psi.

6. Complete charging of system, using new filter dryer core in charging line. Provide full operating charge.

B. Train Owner's maintenance personnel on procedures and schedules related to start-up and shut-down, troubleshooting, servicing, and preventative maintenance of refrigerant piping valves and refrigerant piping specialties.

C. Review data in Operating and Maintenance Manuals.

D. Schedule training with Owner through the Architect, with at least 7 days' advance notice.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air-conditioning systems in pressure classes from minus 2- to plus 10-inch wg (minus 500 to plus 2490 Pa).

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5.

2. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 DEFINITIONS

A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C 168. In this Section, these values are the result of the formula Btu x in./h x sq. ft. x deg F or W/m x K at the temperature differences specified. Values are expressed as Btu or W.

1.3 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select and size air-moving and -distribution equipment and other components of air system. Changes to layout or configuration of duct system must be specifically approved in writing by Engineer. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For duct liner and sealing materials.

C. Shop Drawings: Show details of the following:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.

2. Duct layout indicating pressure classifications and sizes on plans.

3. Fittings.

4. Reinforcement and spacing.

5. Seam and joint construction.

6. Penetrations through fire-rated and other partitions.

7. Terminal unit, and coil, installations.

8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

D. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:

1. Ceiling suspension assembly members.

2. Other systems installed in same space as ducts.

3. Ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.

4. Coordination with ceiling-mounted items, including lighting fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.

E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

F. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices.

1.5 QUALITY ASSURANCE SUBMITTALS

A. Welding Certificates: Copies of certificates indicating welding procedures and personnel comply with requirements in “Quality Assurance” Article.

1.6 QUALITY ASSURANCE

A. Welding Standards: Qualify welding procedures and welding personnel to perform welding processes for this Project according to AWS D1.1, “Structural Welding Code--Steel,” for hangers and supports; AWS D1.2, “Structural Welding Code--Aluminum,” for aluminum supporting members; and AWS D9.1, “Sheet Metal Welding Code,” for duct joint and seam welding.

B. Comply with NFPA 90A, “Installation of Air Conditioning and Ventilating Systems,” unless otherwise indicated.

C. Comply with NFPA 90B, “Installation of Warm Air Heating and Air Conditioning Systems,” unless otherwise indicated.

D. Comply with NFPA 96, “Ventilation Control and Fire Protection of Commercial Cooking Operations,” Chapter 3, “Duct System,” for range hood ducts, unless otherwise indicated.

E. Mockups: Before installing duct systems, erect mockups representing system pressure classifications higher than 2-inch wg (500 Pa). Build mockups to comply with the following requirements, using materials indicated for completed Work:

1. Locate mockups in the locations and of the size indicated or, if not indicated, as directed by Architect. Mockup may be a representative section of the actual duct system.

2. Include the minimum number of each of the following features and fittings:

a. Five transverse joints.

b. One access door.

c. Two typical branch connections, each with at least one elbow.

d. Two typical flexible duct or flexible connector connections for each duct and apparatus.

3. Perform tests specified in “Field Quality Control” Article. Modify mockup construction and perform additional tests as required to achieve specified minimum acceptable results.

4. Obtain Engineer’s approval of mockups before starting Work.

5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work. When directed, demolish and remove mockups from Project site.

6. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

1.7 QUALITY ASSURANCE SUBMITTALS

A. Manufacturer’s Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver sealant and firestopping materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle sealant and firestopping materials according to manufacturer’s written recommendations.

C. Deliver and store stainless-steel sheets with mill-applied adhesive protective paper maintained through fabrication and installation.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.

B. Stainless Steel: ASTM A 480/A 480M, Type 316, sheet form with No. 4 finish for surfaces of ducts exposed to view; and Type 304, sheet form with No. 1 finish for concealed ducts.

C. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 DUCT LINER

A. General: Comply with NFPA 90A or NFPA 90B and NAIMA’s “Fibrous Glass Duct Liner Standard.”

B. Materials: ASTM C 1071 with coated surface exposed to airstream to prevent erosion of glass fibers.

1. Thickness: 1 inch (25 mm).

2. Thermal Conductivity (k-Value): 0.26 at 75E F (0.037 at 24E C) mean temperature.

3. Fire-Hazard Classification: Maximum flame-spread rating of 25 and smoke-developed rating of 50, when tested according to ASTM C 411.

4. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and ASTM C 916.

5. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.

   a. Tensile Strength: Indefinitely sustain a 50-lb- (23-kg-) tensile, dead-load test perpendicular to duct wall.

   b. Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch (3 mm) into airstream.

   c. Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.

2.3 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term “sealant” is limited to materials of adhesive or mastic nature.

1. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 66 percent solids.

2. Flanged Joint Mastics: One-part, acid-curing, silicone, elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

2.4 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for building materials.

1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.

2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

B. Hanger Materials: Galvanized, sheet steel or round, threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rod or galvanized rods with threads painted after installation.

2. Straps and Rod Sizes: Comply with SMACNA’s “HVAC Duct Construction Standards--Metal and Flexible” for sheet steel width and thickness and for steel rod diameters.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

1. Supports for Galvanized-Steel Ducts: Galvanized steel shapes and plates.

2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.

3. Supports for Aluminum Ducts: Aluminum support materials, unless materials are electrolytically separated from ductwork.

2.5 RECTANGULAR DUCT FABRICATION

A. General: Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized, sheet steel, according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

2. Materials: Free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

B. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:

1. Supply Ducts: 3-inch wg (750 Pa).
2. Return Ducts: 2-inch wg (500 Pa), negative pressure.
3. Exhaust Ducts: 2-inch wg (500 Pa), negative pressure.

C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359 inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of unbraced panel area, unless ducts are lined.

2.6 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS

A. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness are prohibited.

B. Apply adhesive to liner facing in direction of airflow not receiving metal nosing.

C. Butt transverse joints without gaps and coat joint with adhesive.

D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

E. Do not apply liners in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

F. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).

G. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely around perimeter; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.

H. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profile or are integrally formed from duct wall. Fabricate edge facings at the following locations:

1. Fan discharge.
2. Intervals of lined duct preceding unlined duct.
3. Upstream edges of transverse joints in ducts.

I. Secure insulation liner with perforated sheet metal liner of same metal thickness as specified for duct, secured to ducts with mechanical fasteners that maintain metal liner distance from duct without compressing insulation.

1. Sheet Metal Liner Perforations: 3/32-inch (2.4-mm) diameter, with an overall open area of 23 percent.

J. Terminate liner with duct buildouts installed in ducts to attach dampers, turning vane assemblies, and other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct wall with bolts, screws, rivets, or welds. Terminate liner at fire dampers at connection to fire-damper sleeve.

2.7 ROUND AND FLAT-OVAL DUCT FABRICATION

A. General: Diameter as applied to flat-oval ducts in this Article is the diameter of the size of round duct that has a circumference equal to perimeter of a given size of flat-oval duct.

B. Round Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

C. Flat-Oval Ducts: Fabricate supply ducts with standard spiral lock seams or with butt-welded longitudinal seams according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

D. Double-Wall (Insulated) Ducts: Fabricate double-wall (insulated) ducts with an outer shell and an inner liner. Dimensions indicated on internally insulated ducts are inside dimensions.

1. Thermal Conductivity (k-Value): 0.26 at 75° F (0.037 at 24° C) mean temperature.

2. Outer Shell: Base outer-shell metal thickness on actual outer-shell dimensions. Fabricate outer-shell lengths 2 inches (50 mm) longer than inner shell and insulation, and in metal thickness specified for single-wall duct.

3. Insulation: 1-inch- (25-mm-) thick fibrous-glass insulation, unless otherwise indicated. Terminate insulation where internally insulated duct connects to single-wall duct or uninsulated components. Terminate insulation and reduce outer duct diameter to inner liner diameter.

4. Solid Inner Liner: Fabricate round and flat-oval inner liners with solid sheet metal of thickness listed below:

5. Perforated Inner Liner: Fabricate round and flat-oval inner liners with sheet metal having 3/32-inch- (2.4-mm-) diameter perforations, with an overall open area of 23 percent. Use the following sheet metal thicknesses and seam construction:

a. Ducts 3 to 8 Inches (75 to 200 mm) in Diameter: 0.019 inch (0.5 mm) with standard spiral seam construction.

b. Ducts 9 to 42 Inches (225 to 1070 mm) in Diameter: 0.019 inch (0.5 mm) with single-rib spiral seam construction.

c. Ducts 44 to 60 Inches (1120 to 1525 mm) in Diameter: 0.022 inch (0.55 mm) with single-rib spiral seam construction.

d. Ducts 62 to 88 Inches (1575 to 2235 mm) in Diameter: 0.034 inch (0.85 mm) with standard spiral seam construction.

6. Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.

2.8 ROUND AND FLAT-OVAL SUPPLY AND EXHAUST FITTING FABRICATION

A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal seam straight duct.

B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.

C. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate bend radius of die-formed, gored, and pleated elbows one and one-half times elbow diameter. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg (minus 500 to plus 500 Pa):

a. Ducts 3 to 26 Inches (75 to 660 mm) in Diameter: 0.028 inch (0.7 mm).
b. Ducts 27 to 36 Inches (685 to 915 mm) in Diameter: 0.034 inch (0.85 mm).
c. Ducts 37 to 50 Inches (940 to 1270 mm) in Diameter: 0.040 inch (1.0 mm).
d. Ducts 52 to 60 Inches (1320 to 1525 mm) in Diameter: 0.052 inch (1.3 mm).
e. Ducts 62 to 84 Inches (1575 to 2130 mm) in Diameter: 0.064 inch (1.6 mm).

3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg (500 to 2490 Pa):

a. Ducts 3 to 14 Inches (75 to 355 mm) in Diameter: 0.028 inch (0.7 mm).
b. Ducts 15 to 26 Inches (380 to 660 mm) in Diameter: 0.034 inch (0.85 mm).
c. Ducts 27 to 50 Inches (685 to 1270 mm) in Diameter: 0.040 inch (1.0 mm).
d. Ducts 52 to 60 Inches (1320 to 1525 mm) in Diameter: 0.052 inch (1.3 mm).
e. Ducts 62 to 84 Inches (1575 to 2130 mm) in Diameter: 0.064 inch (1.6 mm).

4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal seam flat-oval duct.

5. 90-Degree, Two-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material-handling classes A and B; and only where space restrictions do not permit using 1.5 bend radius elbows. Fabricate with single-thickness turning vanes.

6. Round Elbows, 8 Inches (200 mm) and Smaller: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configuration or nonstandard diameter elbows with gored construction.

7. Round Elbows, 9 through 14 Inches (225 through 355 mm): Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees, unless space restrictions require a mitered elbow. Fabricate nonstandard bend-angle configuration or nonstandard diameter elbows with gored construction.

8. Round Elbows, Larger Than 14 Inches (355 mm), and All Flat-Oval Elbows: Fabricate gored elbows, unless space restrictions require a mitered elbow.

9. Die-Formed Elbows for Sizes through 8 Inches (200 mm) and All Pressures: 0.040 inch (1.0 mm) thick with two-piece welded construction.

10. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.

11. Flat-Oval Elbow Metal Thickness: Same as longitudinal seam flat-oval duct specified above.

12. Pleated Elbows for Sizes through 14 Inches (355 mm) and Pressures through 10-Inch wg (2490 Pa): 0.022 inch (0.55 mm).

D. Double-Wall (Insulated) Fittings: Fabricate double-wall (insulated) fittings with an outer shell and an inner liner. Dimensions indicated on internally insulated ducts are inside dimensions.

1. Thermal Conductivity (k-Value): 0.26 at 75° F (0.037 at 24° C) mean temperature.

2. Outer Shell: Base outer-shell metal thickness on actual outer-shell dimensions. Fabricate outer-shell lengths 2 inches (50 mm) longer than inner shell and insulation. Use the same metal thicknesses for outer duct as for uninsulated fittings.

3. Insulation: 1-inch- (25-mm-) thick fibrous-glass insulation, unless otherwise indicated. Terminate insulation where internally insulated duct connects to single-wall duct or uninsulated components. Terminate insulation and reduce outer duct diameter to nominal single-wall size.

4. Solid Inner Liner: Fabricate round and flat-oval inner liners with solid sheet metal of thickness listed below:

5. Perforated Inner Liner: Fabricate round and flat-oval inner liners with sheet metal having 3/32-inch- (2.4-mm-) diameter perforations, with an overall open area of 23 percent. Use the following sheet metal thicknesses:

a. Ducts 3 to 34 Inches (75 to 865 mm) in Diameter: 0.028 inch (0.7 mm).
b. Ducts 35 to 58 Inches (890 to 1475 mm) in Diameter: 0.034 inch (0.85 mm).
c. Ducts 60 to 88 Inches (1525 to 2235 mm) in Diameter: 0.040 inch (1.0 mm).

6. Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

A. Drawings indicate general arrangement of ducts, fittings, and accessories. Provide all required fittings, accessories and ancillaries as required for a complete system as determined by the Engineer.

B. Construct and install each duct system for the specific duct pressure classification indicated.

C. Install round and flat-oval ducts in lengths not less than 12 feet (3.7 m), unless interrupted by fittings.

D. Install ducts with fewest possible joints.

E. Install fabricated fittings for changes in directions, changes in size and shape, and connections.

F. Install couplings tight to duct wall surface with a minimum of projections into duct.

G. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.

H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

I. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

J. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.

K. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

L. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 1-1/2 inches (38 mm).

N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire damper, sleeve, and firestopping sealant. Refer to other sections for fire and smoke damper specifications as well as fire stopping specifications.

O. For exposed duct to be painted, maintain clean, grease, oil and dirt free. Coordinate scheduling of priming and painting of ductwork prior to installation.

3.2 PVC-COATED DUCT INSTALLATION

A. Install PVC-coated duct and fittings according to manufacturer’s written instructions.

B. Seal all joints and seams. Apply sealer to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

C. Secure couplings with sheet metal screws. Install screws at an interval of 12 inches (300 mm), with a minimum of three screws in each coupling.

D. Repair damage to PVC coating with manufacturer’s recommended materials.

3.3 UNDERSLAB DUCT INSTALLATIONS

A. Verify undamaged conditions of duct before enclosure with fill or encasement.

B. Install underslab ducts according to SMACNA’s “HVAC Duct Construction Standards--Metal and Flexible” and as indicated.

C. Protect ducts from damage by equipment used in placing concrete on or around ducts.

D. Protect duct openings.

3.4 SEAM AND JOINT SEALING

A. General: Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Pressure Classification Less Than 2-Inch wg (500 Pa): Transverse joints.

C. Seal externally insulated ducts before insulation installation.

3.5 HANGING AND SUPPORTING

A. Install rigid round, rectangular, and flat-oval metal duct with support systems indicated in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

C. Support vertical ducts at a maximum interval of 16 feet (5 m) and at each floor.

D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

E. Install concrete inserts before placing concrete.

F. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3.6 CONNECTIONS

A. Connect equipment with flexible connectors according to other Sections.

B. For branch, outlet and inlet, and terminal unit connections, comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

3.7 FIELD QUALITY CONTROL

A. Disassemble, reassemble, and seal segments of systems as required to accommodate leakage testing and as required for compliance with test requirements.

B. Conduct tests, in presence of Architect, at static pressures equal to maximum design pressure of system or section being tested. If pressure classifications are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.

C. Determine leakage from entire system or section of system by relating leakage to surface area of test section.

D. Maximum Allowable Leakage: Comply with requirements for Leakage Classification 3 for round and flat-oval ducts, Leakage Classification 12 for rectangular ducts in pressure classifications less than and equal to 2-inch wg (500 Pa) (both positive and negative pressures), and Leakage Classification 6 for pressure classifications from 2- to 10-inch wg (500 to 2490 Pa).

E. Remake leaking joints and retest until leakage is less than maximum allowable.

F. Leakage Test: Perform tests according to SMACNA's "HVAC Air Duct Leakage Test Manual."

3.8 ADJUSTING

A. Adjust volume-control dampers in ducts, outlets, and inlets to achieve design airflow.

B. Detailed procedures for Testing, Adjusting, and Balancing are specified in other Sections.

3.9 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect the system. Vacuum ducts before final acceptance to remove dust and debris.

END OF SECTION 233113

SECTION 233300 - DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Backdraft dampers.
2. Manual-volume dampers.
3. Fire and smoke dampers.
4. Turning vanes.
5. Duct-mounted access doors and panels.
6. Flexible ducts.
7. Flexible connectors.
8. Duct accessory hardware.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5.

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For the following products.

1. Backdraft dampers.
2. Manual-volume dampers.
3. Fire dampers.
4. Duct silencers.
5. Duct-mounted access doors and panels.
6. Flexible ducts.

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:

1. Special fittings and manual- and automatic-volume-damper installations.

2. Fire- and smoke-damper installations, including sleeves and duct-mounted access doors and panels.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire dampers to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.4 QUALITY ASSURANCE

A. NFPA Compliance: Comply with the following NFPA standards:

1. NFPA 90A, “Installation of Air Conditioning and Ventilating Systems.”
2. NFPA 90B, “Installation of Warm Air Heating and Air Conditioning Systems.”

1.5 QUALITY ASSURANCE SUBMITTALS

A. Manufacturer’s Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 (Z275) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.

B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.

C. Aluminum Sheets: ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14, sheet form; with standard, one-side bright finish for ducts exposed to view and mill finish for concealed ducts.

D. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for 36-inch (900-mm) length or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 BACKDRAFT DAMPERS

A. Description: Suitable for horizontal or vertical installations.

B. Frame: 0.052-inch- (1.3-mm-) thick, galvanized, sheet steel, with welded corners and mounting flange.

C. Blades: 0.025-inch- (0.6-mm-) thick, roll-formed aluminum.

D. Blade Seals: Neoprene.

E. Blade Axles: Nonferrous.

F. Blade Axles: Galvanized steel.

G. Tie Bars and Brackets: Galvanized steel.

H. Return Spring: Adjustable tension.

2.3 MANUAL-VOLUME DAMPERS

A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Pressure Classifications of 3-Inch wg (750 Pa) or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

B. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.

2. Aluminum Frames: Hat-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.

3. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized, sheet steel.

4. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.

5. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.

6. Blade Axles: Nonferrous.

7. Blade Axles: Galvanized steel.

8. Tie Bars and Brackets: Aluminum.

9. Tie Bars and Brackets: Galvanized steel.

D. Low-Leakage Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

E. Low-Leakage Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.

2. Aluminum Frames: Hat-shaped, 0.063-inch- (1.6-mm-) thick, extruded-aluminum channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.

3. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized, sheet steel.

4. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.

5. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.

6. Blade Seals: Felt.

7. Blade Seals: Vinyl.

8. Blade Seals: Neoprene.

9. Blade Axles: Nonferrous.

10. Blade Axles: Galvanized steel.

11. Tie Bars and Brackets: Aluminum.

12. Tie Bars and Brackets: Galvanized steel.

F. High-Performance Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.

2. Aluminum Frames: Hat-shaped, 0.125-inch- (3-mm-) thick, extruded-aluminum channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.

3. Steel Blades: 0.052-inch- (1.3-mm-) thick, galvanized, sheet steel; airfoil shaped.

4. Extruded-Aluminum Blades: Minimum of 0.081-inch- (2-mm-) thick, 6063T extruded aluminum.

5. Blade Seals: Dual-durometer vinyl on blade edges; metallic compression on jambs.

6. Blade Axles: Nonferrous.

7. Blade Axles: Galvanized steel.

8. Tie Bars and Brackets: Aluminum.

9. Tie Bars and Brackets: Galvanized steel.

G. Jackshaft: 1-inch- (25-mm-) diameter, galvanized steel pipe rotating within a pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper of a multiple-damper assembly.

H. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.4 FIRE DAMPERS

A. General: Labeled to UL 555.

B. Fire Rating: One and one-half hours.

C. Fire Rating: One and one-half and three hours.

D. Frame: SMACNA Type A with blades in airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

E. Frame: SMACNA Type B with blades out of airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed galvanized, sheet steel.

1. Minimum Thickness: 0.052 inch (1.3 mm) or 0.138 inch (3.5 mm) thick as indicated, and length to suit application.

2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized, sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized steel blade connectors.

I. Horizontal Dampers: Include a blade lock and stainless-steel negator closure spring.

J. Fusible Link: Replaceable, 165 or 212° F (74 or 100° C) rated as indicated.

2.5 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Manufactured Turning Vanes: Fabricate of 1-1/2-inch- (38-mm-) wide, curved blades set 3/4 inch (19 mm) o.c.; support with bars perpendicular to blades set 2 inches (50 mm) o.c.; and set into side strips suitable for mounting in ducts.

2.6 DUCT-MOUNTED ACCESS DOORS AND PANELS

A. General: Fabricate doors and panels airtight and suitable for duct pressure class.

B. Frame: Galvanized, sheet steel, with bend-over tabs and foam gaskets.

C. Door: Double-wall, galvanized, sheet metal construction with insulation fill and thickness, and number of hinges and locks as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.

D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

E. Insulation: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.7 FLEXIBLE CONNECTORS

A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

1. Standard Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.

B. Extra-Wide Metal-Edged Connectors: Factory fabricated with a strip of fabric 5-3/4 inches (146 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.

C. Transverse Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches (89 mm) wide attached to two strips of 4-3/8-inch- (111-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized, sheet steel or 0.032-inch (0.8-mm) aluminum sheets. Select metal compatible with connected ducts.

D. Conventional, Indoor System Flexible Connector Fabric: Glass fabric double coated with polychloroprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).

2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp, and 360 lbf/inch (63 N/mm) in the filling.

E. Conventional, Outdoor System Flexible Connector Fabric: Glass fabric double coated with a synthetic-rubber, weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).

2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp, and 440 lbf/inch (77 N/mm) in the filling.

2.8 FLEXIBLE DUCTS

A. General: Comply with UL 181, Class 1.

B. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch- (38-mm-) thick, glass-fiber insulation around a continuous inner liner.

1. Reinforcement: Steel-wire helix encapsulated in inner liner.

2. Outer Jacket: Glass-reinforced, silver Mylar with a continuous hanging tab, integral fibrous-glass tape, and nylon hanging cord.

3. Outer Jacket: Polyethylene film.

4. Inner Liner: Polyethylene film.

C. Pressure Rating: 6-inch wg (1500 Pa) positive, 1/2-inch wg (125 Pa) negative.

2.9 ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments, and length to suit duct insulation thickness.

B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch (6-mm), zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.

C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches (75 to 450 mm) to suit duct size.

D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.

B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.

C. Provide test holes at fan inlet and outlet and elsewhere as indicated.

D. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.

1. Install fusible links in fire dampers.

E. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.

1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.

2. Install access panels on side of duct where adequate clearance is available.

3. Install fire damper duct access panels within reach of fusible links.

F. Label access doors according to other Sections.

G. Flexible ducts shall be a maximum length of 4 feet. Provide a rigid elbow at connection to ceiling mounted registers, diffusers, and grilles. Flexible ducts shall only be used on supply air ductwork systems. Flexible ducts shall not be used on return and exhaust air systems.

3.2 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire and smoke dampers for proper action.

C. Final positioning of manual-volume dampers is specified in other Sections.

END OF SECTION 233300

SECTION 233319 DUCT SILENCERS

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Division 01, High Performance Buildings Requirements Section 018113.13.
1. HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 SUMMARY

A. This section includes duct silencers.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13.

C. HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include catalog cuts, dynamic insertion loss ratings, aerodynamic performance data, and noise power levels.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of duct silencer to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For each type of duct silencer specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Industrial Acoustics Co.

B. Keene

C. Gale

2.2 MATERIALS AND CONSTRUCTION

A. Outer casings of rectangular silencers shall be made of 22 gauge galvanized steel in accordance with ASHRAE recommended construction for high pressure rectangular duct work. Seams shall be lock formed and mastic filled.

B. Outer casings of tubular silencers shall be made of galvanized steel ranging from 18 to 22 gauge according to silencer sizes as recommended by Manufacturer. Interior partitions for rectangular silencers shall be made of not less than 26 gauge galvanized perforated steel. Interior construction of tubular silencers shall be compatible with the outside casings.

C. Filler material shall be of inorganic mineral or glass fiber of a density sufficient to obtain the specified acoustic performance and be packed under not less than 5% compression to eliminate voids due to vibration and settling. Material shall be inert, vermin and moisture proof.

D. Combustion rating for the silencer acoustic fill shall be not less than the following when tested in accordance with ASTME 84, NFPA Standard 255 or UL No. 723:

1. Flamespread Classification25
2. Smoke Development Rating15
3. Fuel Contribution20

E. Air tight construction shall be provided by use of a duct sealing compound on the job site. Silencers shall not fail structurally when subjected to a differential air pressure of 8 iwg inside to outside of casing.

2.3 ACOUSTIC PERFORMANCE

A. Silencer ratings shall be determined in a duct-to-reverberant room test facility which provides for airflow in both directions through the text silencer in accordance with ASTM Specification E 477. Acoustic ratings shall include Dynamic Insertion Loss (DIL) and Self- Noise (SN) power levels both for forward flow (air and noise in same direction) and reverse flow (air and noise in same direction) and reverse flow (air and noise in opposite directions) with air flow of at least 2,000 FPM entering face velocity.

2.4 AERODYNAMIC PERFORMANCE

A. Static pressure loss of silencers shall not exceed those listed in the silencer schedule. Air flow measurements shall be made in accordance with ASTM Specifications E 477 and applicable portions of ASME, AMCA, and ADC Airflow Test Codes. Test shall be reported on the identical units for which acoustic data is presented.

2.5 CERTIFICATION

A. The Manufacturer shall include with submittals certified test data on dynamic insertion loss, self-noise power levels, and aerodynamic performance for reverse and forward flow test conditions. Test data shall be for a standard product. All rating tests shall be conducted in the same facility and shall utilize the same silencer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Model numbers and sizes have been selected to match in size and shape the designated air handler unit and associated ductwork. If other than the base design manufacturer is selected, care must be exercised that silencers properly mate to ductwork and equipment.

B. Provide transitions as required to adapt from silencer dimensions to connecting ductwork.

C. Provide all required hangers and supports as required and as shown on the drawings.

END OF SECTION 233319

SECTION 233400 FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes the following types fans:

1. Inline centrifugal fans.
2. Power ventilators: roof- and wall-mounted exhausters.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13.

2. HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each product.

1. Include specialties, accessories, and the following.

a. Certified fan performance curves with system operating conditions indicated.
b. Certified fan sound power ratings.
c. Motor ratings and electrical characteristics plus motor and fan accessories.
d. Materials gages and finishes, including color charts.
e. Dampers, including housings, linkages, and operators.

C. Shop Drawings: Detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

D. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer installed wiring and field installed wiring.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fans to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For fans manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 QUALITY ASSURANCE

A. UL Compliance: Fans and components shall be UL listed and labeled.

B. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

C. Electrical Component Standard: Components and installation shall comply with NFPA 70 “National Electrical Code.”

1.6 EXTRA MATERIALS

A. Furnish one additional complete set of belts for each belt-driven fan.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Inline Centrifugal Fans:

a. Cook (Loren) Co.
b. Greenheck Fan Corp.
c. Penn/Barry

2. Centrifugal Roof Ventilators:

a. Cook (Loren) Co.
b. Greenheck Fan Corp.
c. Penn/Barry

2.2 SOURCE QUALITY CONTROL

A. Testing Requirements: The following factory tests are required:

1. Sound Power Level Ratings: Comply with AMCA Standard 301 “Method for Calculating Fan Sound Ratings From Laboratory Test Data.” Test fans in accordance with AMCA Standard 300 “Test Code for Sound Rating.” Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.

2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

2.3 FANS, GENERAL

A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished, with indicated capacities and characteristics.

B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.

1. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan class.

C. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor: 1.4.

D. Belts: Oil-resistant, nonsparking, and nonstatic.

E. Motor and Fan Wheel Pulleys: Adjustable pitch for use with motors. Select pulley so that pitch adjustment is at the middle of the adjustment range at fan design conditions.

1. Belt Guards: Provide steel belt guards for motors mounted on the outside of the fan cabinet.

F. Shaft Bearings: Provide type indicated, having a median life "Rating Life" (AFBMA (L50)) of 200,000, calculated in accordance with AFBMA Standard 9 for ball bearings and AFBMA Standard 11 for roller bearings.

G. Factory Finish: The following finishes are required:

1. Sheet Metal Parts: Prime coating prior to final assembly.
2. Exterior Surfaces: Baked-enamel finish coat after assembly.

H. Motors:

1. Refer to other Sections for motor equipment.
2. Provide fan motors rated for inverter duty where applicable.

2.4 INLINE CENTRIFUGAL FANS

A. General Description: Inline, belt-driven, centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, drive assembly, motor and disconnect switch, mounting brackets, and accessories.

B. Housing: Split, spun-aluminum housing, with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units: Motor encased in housing out of air stream, factory-wired to disconnect located on outside of fan housing.

D. Belt-Drive Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Wheel: Aluminum, airfoil blades welded to aluminum hub.

F. Accessories: The following accessories are required as indicated:

1. Volume Control Damper: Manual operated with quadrant lock, located in fan outlet.

2. Companion Flanges: For inlet and outlet duct connections.

3. Fan Guards: Expanded metal in removable frame.

4. Speed Control: Variable speed switch with on-off control and speed control for 100 to 50 percent of fan air delivery.

2.5 CENTRIFUGAL ROOF VENTILATORS

A. General Description: Belt-driven or direct-drive as indicated, centrifugal consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

B. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; square, one-piece, hinged, aluminum base with venturi inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

D. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:

1. Pulleys: Cast-iron, adjustable-pitch.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
4. Fan and motor isolated from exhaust air stream.

E. Motor shall be open drip proof type.

F. Accessories: The following items are required as indicated:

1. Disconnect Switch: Nonfusible type, with thermal overload protection mounted inside fan housing, factory-wired through an internal aluminum conduit.

2. Bird Screens: Removable 1/2-inch mesh, 16-gage, aluminum or brass wire.

3. Dampers: Motor-operated, parallel-blade, dampers mounted in curb base.

a. Blades: Die-formed sheet aluminum.
b. Frame: Extruded aluminum, with waterproof, felt blade seals.
c. Linkage: Nonferrous metals, connecting blades to operator.
d. Operators: Manufacturer’s standard electric motor.

4. Roof Curbs: Prefabricated, heavy-gage, galvanized steel; mitered and welded corners; 2-inch-thick, rigid, fiberglass insulation adhered to inside walls; built-in cant and mounting flange for flat roof decks; and 2-inch wood nailer. Size as required to suit roof opening and fan base.

a. Overall Height: 12 inches.

2.6 MOTORS

A. Torque Characteristics: Sufficient to accelerate the driven loads satisfactorily.

B. Motor Sizes: Minimum sizes and electrical characteristics as indicated. If not indicated, large enough so that the driven load will not require the motor to operate in the service factor range.

C. Temperature Rating: 50°C maximum temperature rise at 40°C ambient for continuous duty at full load (Class A Insulation).

D. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.

E. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design B. Provide permanent-split capacitor classification motors for shaft-mounted fans and capacitor start classification for belted fans.

1. Bases: Adjustable.

2. Bearings: The following features are required:

a. Ball or roller bearings with inner and outer shaft seals.

b. Grease lubricated.

c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.

3. Enclosure Type: The following features are required:

a. Open dripproof motors where satisfactorily housed or remotely located during operation.

b. Guarded dripproof motors where exposed to contact by employees or building occupants.

4. Overload protection: Built-in, automatic reset, thermal overload protection.

5. Noise rating: Quiet.

6. Efficiency: Energy-efficient motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, Test Method B. If efficiency not specified, motors shall have a higher efficiency than “average standard industry motors” in accordance with IEEE Standard 112, Test Method B.

7. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, and special features.

F. Starters, Electrical Devices, and Wiring: Electrical devices and connections are specified in other Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances, housekeeping pads, and other conditions affecting performance of fans.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install fans level and plumb, in accordance with manufacturer’s written instructions. Support units as described below, using the vibration control devices indicated. Vibration control devices are specified in Division 23 Section “Mechanical Vibration Controls and Seismic Restraints”.

1. Support floor-mounted units on concrete equipment bases using neoprene pads. Secure units to anchor bolts installed in concrete equipment base.

2. Support floor-mounted units on concrete equipment bases using housed spring isolators. Secure units to anchor bolts installed in concrete equipment base.

3. Secure roof-mounted fans to roof curbs with cadmium-plated hardware.

a. Installation of roof curbs is specified in other Sections.

4. Suspended Units: Suspend units from structural steel support frame using threaded steel rods and vibration isolation springs.

B. Arrange installation of units to provide access space around air- handling units for service and maintenance.

3.3 CONNECTIONS

A. Duct installations and connections are specified in other Sections. Make final duct connections with flexible connections.

B. Electrical Connections: The following requirements apply:

1. Electrical power wiring is specified in other Divisions.

2. Temperature control wiring and interlock wiring are specified in Division 23.

3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Inspection: Arrange and pay for a factory- authorized service representative to perform the following:

1. Inspect the field assembly of components and installation of fans including ductwork and electrical connections.

2. Prepare a written report on findings and recommended corrective actions.

3.5 ADJUSTING, CLEANING, AND PROTECTING

A. Adjust damper linkages for proper damper operation.

B. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.6 COMMISSIONING

A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:

1. Remove shipping blocking and bracing.

2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.

3. Perform cleaning and adjusting specified in this Section.

4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.

5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.

6. Verify manual and automatic volume control and that fire and smoke dampers in connected ductwork systems are in the full-open position.

7. Disable automatic temperature control operators.

B. Starting procedures for fans:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.

a. Replace fan and motor pulleys as required to achieve design conditions.

2. Measure and record motor electrical values for voltage and amperage.

C. Shut unit down and reconnect automatic temperature control operators.

D. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for procedures for air-handling-system testing, adjusting, and balancing.

3.7 DEMONSTRATION

A. Demonstration Services: Arrange and pay for a factory-authorized service representative to train Owner's maintenance personnel on the following:

1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.

2. Familiarization with contents of Operating and Maintenance Manuals.

B. Schedule training with at least 7 days' advance notice.

END OF SECTION 233400

SECTION 233600 AIR TERMINALS

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Division 01, High Performance Buildings Requirements Section 018113.13.

1. HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 SUMMARY

A. This Section includes the following:

1. Single-duct air terminals (VAV boxes).

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13.

2. HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model indicated. Include a schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished.

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

D. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating air outlets with other items installed in ceilings.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of air terminal to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For each type of air terminal specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings and schedules indicate requirements of air terminals and are based on specific systems indicated. Other manufacturers' systems with equal performance characteristics may be considered.

B. Listing and Labeling: Provide electrically operated air terminals specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

C. NFPA Compliance: Install air terminals according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

D. Comply with NFPA 70 for electrical components and installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering air terminals that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide air terminals by one of the following:

1. Air System Components; Krueger Div.
2. Nailor Industries Inc.
3. Titus.

2.2 SINGLE-DUCT AIR TERMINALS

A. Configuration: Volume-damper assembly inside unit casing. Locate control components inside protective metal shroud.

B. Casings: Steel or aluminum sheet metal of the following minimum thicknesses:

1. Upstream Pressure Side: 0.0239-inch (0.6-mm) steel.
2. Downstream Pressure Side: 0.0179-inch (0.45-mm) steel.
3. Upstream Pressure Side: 0.032-inch (0.8-mm) aluminum.
4. Downstream Pressure Side: 0.025-inch (0.63-mm) aluminum.

C. Casing Lining: Minimum of 1/2-inch- (13-mm-) thick, neoprene- or vinyl-coated, fibrous-glass insulation; 1.5-lb/cu. ft. (24-kg/cu. m) density, complying with NFPA 90A requirements and UL 181 erosion requirements. Secure lining to prevent delamination, sagging, or settling.

1. Coat liner surfaces and edges with erosion-resistant coating or cover with perforated metal.

D. Plenum Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.

E. Plenum Air Outlets: S-slip and drive connections.

F. Access: Removable panels to permit access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.

G. Volume Damper: Construct of galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: 2 percent of nominal airflow at 1-inch wg (250-Pa) inlet static pressure.

H. Hot-Water Heating Coil: 1/2-inch (13-mm) copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig (1380 kPa); and factory installed.

I. Controls: Coordinate provision of controls with project controls contractor.

2.3 SOURCE QUALITY CONTROL

A. Testing Requirements: Test and rate air terminals according to ARI 880, “Industry Standard for Air Terminals.”

B. Identification: Label each air terminal with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminals level and plumb, according to manufacturer’s written instructions, rough-in drawings, original design, and referenced standards; and maintain sufficient clearance for normal service and maintenance.

B. Connect ductwork to air terminals according to other Sections.

3.2 CONNECTIONS

A. Install piping adjacent to air terminals to allow service and maintenance.

B. Hot-Water Piping: Connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

C. Electrical: Comply with applicable requirements in other Sections.

D. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer’s published torque-tightening values. Where manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

3.5 COMMISSIONING

A. Verify that installation of each air terminal is according to the Contract Documents.

B. Check that inlet duct connections are as recommended by air terminal manufacturer to achieve proper performance.

C. Check that controls and control enclosure are accessible.

D. Verify that control connections are complete.

E. Check that nameplate and identification tag are visible.

F. Verify that controls respond to inputs as specified.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

2. Review data in the maintenance manuals. Refer to Division 1 Section "Contract Closeout."

3. Review data in the maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."

4. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

END OF SECTION 233600

SECTION 233713 DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5.

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 DEFINITIONS

A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.

B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.

C. Register: A combination grille and damper assembly over an air opening.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.

2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.

3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.

4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.

C. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated. Other manufacturers' products with equal performance characteristics may be considered.

B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, “Standard for the Installation of Air-Conditioning and Ventilating Systems.”

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Diffusers, registers, and grilles are scheduled on Drawings.

B. Acceptable Manufacturers:

1. Nailor
2. Titus
3. Kreuger

2.2 SOURCE QUALITY CONTROL

A. Testing: Test performance according to ASHRAE 70, “Method of Testing for Rating the Performance of Air Outlets and Inlets.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb, according to manufacturer’s written instructions, Coordination Drawings, original design, and referenced standards.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other items conflict with installation, notify Engineer for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

3.5 DIFFUSER, REGISTER and GRILLE SCHEDULE

A. Provide integral volume damper adjustable thru face as noted on Register, Grille and Diffuser schedule M602.

B. Supply Diffuser (SD-1, SD-5, SD-6)

1. Type: Drum louvers of type and size as shown on plans and schedule.
2. Material: Extruded aluminum
3. Finish: Baked enamel, color selection by architect.
4. Duct connection: Drum louver shall be connected to exposed ductwork.
5. Face Size: See plans and schedule.
6. Maximum Noise – Criterion Rating: See schedule.
7. Face Style: Drum louver.
8. Mounting: Mount directly to exposed ductwork through gasketed frame.
9. Pattern: Adjustable with cylindrical drums tightly pivoted to the end caps. Paddle-size deflection vanes are rear pivoted on nylon bushings in the rectangular drum openings.
10. Dampers: Adjustable opposed blade

C. Supply Diffuser (SD-2, T-Bar, SD-3, GYP)

1. Type: Square “panel”, size as per schedule.
2. Material” Corrosion-resistant steel
3. Finish: baked enamel, color selected by architect.
4. Duct connection: Round.
5. Face Size: 24” x 24”
6. Maximum Noise-criterion Rating: See schedule.
7. Face Style: Stamped steel outer cone, plaque style face inner cone.
8. Mounting: SD-2, lay-in, T-bar – SD-3, surface, GYP board with frame.
9. Pattern: Fixed
10. Dampers: Adjustable radial opposed blade as scheduled.

D. Supply Diffuser (SD-4)

1. Type: Linear slot diffuser for “techzone” type ceilings. Size as per schedule.
2. Material: Extruded aluminum
3. Finish: Appliance white with black pattern controllers.
4. Duct Connection: Linear slot diffuser plenum with round or oval connection
5. Face Size: See plans and schedule.
6. Maximum Noise Criterion Rating: See schedule.
7. Face Style: Linear slot diffuser, 2-slots, 1” slots.
8. Mounting: Linear slot diffuser shall be adaptable for a “techzone:” type ceiling.
9. Pattern: Adjustable with “ice tong” pattern controllers.

E. Supply Diffuser (SD-7, SD-8) & Return Grille (RR-4, RR-6)

1. Type: Reversible core
2. Material: Aluminum
3. Finish: Baked enamel color as selected by Architect
4. Neck Size: See Plans
5. Maximum Noise-criterion Rating: See Schedule.
6. Mounting: See Plans
7. Pattern: Adjustable with core placement.
8. Dampers: Adjustable opposed blade as scheduled.

F. Supply Registers (SR-1, SR-1A)

1. Type: Louvered size as per Plans.
2. Material: SR-1, Corrosion-resistant steel – SR-1A Aluminum.
3. Finish: Baked enamel color as selected by Architect.
4. Duct Connection: See plans for duct connection.
5. Face Size: See Plans
6. Maximum Noise-criterion Rating: See Schedule.
7. Face Style: Louvered with horizontal front bars.
8. Mounting: See Plans
9. Pattern: Double deflection, adjustable.
10. Dampers: Adjustable opposed blade.

G. Return Panel (RR-1, T-Bar, RR-5, GYP)

1. Type: Perforated face.
2. Material: Corrosion resistant steel.
3. Finish: Baked enamel, color as selected by Architect.
4. Duct Connection: Provide lined boot.
5. Face Size: 24” x 24
6. Maximum Noise Criterion Rating: See schedule.
7. Mounting: RR-1, lay-in T-bar, RR-5, surface, GYP board with frame

H. Return Register (RR-2, RR-2A)

1. Type: Louvered size as per plans and schedule.
2. Material: RR-2, Corrosion resistant steel – RR-2A Aluminum.
3. Finish: RR-2, Baked enamel, color as selected by Architect – RR-2A, Mill finish.
4. Duct Connection: See plans for duct connection
5. Face Size: Plans for size
6. Maximum Noise Criterion Rating: See schedule
7. Face Style: Louvers with horizontal front bars.
8. Mounting: Duct mount
9. Pattern: Fixed
10. Dampers: Adjustable opposed blade

I. Return Register (RR-3)

1. Type: Linear slot for “techzone” type ceilings. Size as per schedule.
2. Material: Extruded aluminum
3. Finish: Appliance white, with flat black interior.
4. Face Size: See plans and schedule
5. Mounting: Linear slot return shall be adaptable for a “techzone” type ceiling.
6. Face Style” Linear slot return, 2-slots, 1” slots.

J. Exhaust Register (ER)

1. Type: Louvered, size as per plans and schedule.
2. Material: ER-#, Corrosion resistant steel – ER-#A, Aluminum.
3. Finish: ER-# Baked enamel, color as selected by Architect – ER-#A Mill finish.
4. Duct Connection: See Plans for duct connection.
5. Face Size: See schedule.
6. Maximum Noise Criterion Rating: See schedule.
7. Face Style: Louvered, with horizontal front bars.
8. Mounting: Duct and surface GYP board.
9. Pattern: Fixed
10. Dampers: Adjustable opposed blade as scheduled.

END OF SECTION 233713

SECTION 233723 – GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5.

1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed..

1.2 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include manufacturer's catalog sheets, standard schematic drawings, specifications and installation instructions for each size unit and curb.

PART 2 - PRODUCTS

2.1 OUTSIDE AIR INTAKES AND RELIEF AIR VENTS

A. Design: Outside air intakes and relief air vents shall be of the same style as the power roof ventilators installed on the same roof, or required to be installed on the same roof, unless otherwise indicated on drawings or specified. Units shall be of sectional construction consisting of a base section and a top section or cover. Top section shall be hinged or easily removable for access to inside of base section and curb.

B. Fabrication: Fabricate intakes and relief vents from a heavy gage aluminum, properly braced and stiffened to form a rigid stormproof unit, which will withstand a minimum horizontal pressure of 30 lbs. per square foot of projected area. Provide 1/2" insulation on underside of hood to prevent condensation. Fabricate all hinges, friction catches and other fastening devices from corrosion resistant material, as approved. Intakes and relief openings shall be provided with aluminum (insect-bird) screens. Basic housing materials for the different styles of intakes and vents are as follows:

1. Standard (Low contour rectangular shaped): Sheet aluminum.
2. Dome Shaped: Spun aluminum top section (dome) and anodized sheet aluminum.

C. Alternate: Air intakes and relief vents with formed steel housings may be submitted for approval. Chemically pre-treat steel housings and finish with a minimum 2 coat corrosion resistant enamel.

2.2 ROOF CURBS

A. Fabrication: Factory fabricated, double shell aluminum, a minimum of 2" thick, insulated with mineral wool, or thermally equivalent insulation as approved. Fabricate curbs from minimum No. l8 gage aluminum, properly braced and stiffened to form a rigid weatherproof unit.

B. Dampers: Motor-operated, parallel-blade dampers mounted in curb base. Extruded aluminum frame with waterproof felt blade seals, die formed sheet aluminum blades, nonferrous metals

connecting blades to operator, manufacturer's standard electric motor. Coordinate damper motor voltage with project controls contractor.

C. Manufacture: Curbs shall be the product of the ventilator manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Preliminary Work: Deliver curbs to Construction (Sub) Contractor for installation. Coordinate with the Construction (Sub) Contractor in the locating and sizing of all roof openings required.

B. Secure air intakes and relief air vents to roof curbs, with approved fastening devices.

END OF SECTION 233723

SECTION 235100 BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

B. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5.

1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 SUMMARY

A. This Section specifies double wall metal vents and accessories for gas-fired pressure washer located on M103.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include product literature describing materials of construction and fabrication methods.
2. Manufacturers installation instructions.

C. Shop Drawings: Provide scaled dimensioned fabrication drawings from the product manufacturer including all components for a complete system allowing for expansion and drainage and coordinated with other trades.

1.4 QUALITY ASSURANCE SUBMITTALS

A. Certificates: Submit certificates of materials compliance with specified ASTM, UL, and ASHRAE requirements.

1.5 QUALITY ASSURANCE

A. Codes and Standards:

1. NFPA: Comply with NFPA 211 “Standard for Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances.”

2. UL: Comply with applicable portions of UL safety standards; provide products which have been UL listed and labeled.

3. ASHRAE: Comply with the ASHRAE Equipment Handbook, Chapter 27, for Chimney, Gas Vent, and Fireplace Systems, material requirements and design criteria.

1.6 QUALITY ASSURANCE SUBMITTALS

A. Manufacturer’s Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

PART 2 - PRODUCTS

2.1 DOUBLE WALL METAL VENTS

A. Type B Gas Vents:

1. Acceptable Manufacturers:

a. American Metal Products Co.; Div. of Masco Corp.
b. Hart & Cooley Mfg. Co.
c. Selkirk Metalbestos.

2. Description: Double wall gas vents, UL listed for Type B, consisting of an inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel, with the following minimum thicknesses:

Size	Inner Pipe	Outer Pipe
Round, up to 6"	0.012"	28 gage
Round, 7" to 18"	0.014"	28 gage
Round, 20" to 24"	0.018"	26 gage
Oval, up to 4"	0.012"	28 gage
Oval, 5" to 6"	0.014"	28 gage

3. Accessories: UL-labeled tees, elbows, increasers, draft hood connectors, metal cap with bird barrier, adjustable roof flashing, storm collar, support assembly, thimbles, fire stop spacers, and fasteners, fabricated of similar materials and designs as vent pipe straight sections.

PART 3 - EXECUTION

3.1 INSTALLATION OF DOUBLE WALL CONNECTORS, BREECHINGS, AND VENTS

A. Install Type B gas vents in accordance with manufacturer's installation instructions and UL listing. Maintain minimum clearances from combustibles specified in UL listing.

B. Install all steel, positive pressure, double wall gas vents in accordance with manufacturer's installation instructions and UL listing. Maintain minimum clearances from combustibles specified in UL listing.

C. Seal joints between sections of positive pressure vents in accordance with manufacturer's installation instructions, and using only sealants recommended by manufacturer.

D. Support vents at intervals recommended by the manufacturer to support the weight of the vent and all accessories, without exceeding loading of appliances.

3.2 ADJUSTING AND CLEANING

A. Clean breechings internally during installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth.

3.3 PROTECTION

A. Temporary Closure: At ends of breechings and chimneys which are not completed or connected to equipment, provide temporary closure which will prevent entrance of dust and debris until installations are completed.

END OF SECTION 275100

SECTION 235101 POSITIVE PRESSURE VENTING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section specifies positive pressure venting systems for condensing appliances. Roof flashing is specified in other sections.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13.

2. HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include catalog cut sheets, specifications and installation instructions for each item specified.

C. Shop drawings: Provide scaled dimensioned fabrication drawings from the product manufacturer including all components for a complete system allowing for expansion and drainage and coordinated with other trades.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of vent to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For each type of vent specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Factory built chimneys shall be designed and installed in accordance with the requirements of the NFPA 54, NFPA - 85A,B and D, comply and be listed to UL 1738, Category IV. All components shall be UL listed and labeled for use with building heating equipment.

B. The inner diameter for breeching and stack shall be verified by the manufacturer's computations. The computation shall be technically sound, shall follow ASHRAE calculation methods, and incorporate the specific flow characteristics of the inner pipe. The contractor shall furnish the exact boiler model and operating characteristics to the factory representative. Operating characteristics shall include flue gas flow rate, BTU input, outlet temperature, local altitude, stack layout, and available external pressure at appliance outlet, etc., necessary to determine system operation at maximum and minimum levels of burner turndown range.

C. Technical Services Support: The factory-built modular stack system shall be furnished by a vendor organization which assures design, installation and services coordination; and provides in-warranty and post-warranty unified responsibility.

1.6 WARRANTY

A. Manufacturer shall provide warranty against functional failure due to defects in material and manufacturer's workmanship for a period of ten (10) years from the date of delivery.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, acceptable manufacturer's that may be incorporated into the Work include, but are not limited to, the following:

1. Selkirk Metalbestos, Division of Selkirk, Inc.
2. Metal-Fab Inc
3. Heat Fab Inc.

2.2 MATERIALS:

A. Factory-built modular connector, manifold and stack system laboratory tested and Listed by Underwriters Laboratories, Inc. (UL) for use with building heating equipment and appliances which produce exhausted flue gases at a temperature not exceeding 550°F (see UL1738) when burning gas as described in NFPA54. The stack system shall be designed and installed to be gas tight and tested to 15"w.g. The system shall be designed to compensate for all flue gas induced thermal expansions

B. The double wall stack shall have an inner gas carrying pipe of AL29-4C superferritic stainless steel. There shall be a nominal 1 inch air space between the walls. The outer jacket shall be 304 stainless steel .018" thickness up to 12". The materials and construction of the modular sections and accessories shall be as specified by the terms of the product's UL Listing.

C. Factory supplied Vee Bands and sealant for inner pipe joints as specified in the manufacturer's installation instructions. P077 Silicone Sealant for flue gas temperatures up to 600 degrees. P078 Ceramic Sealant for flue gas temperatures over 600 degrees.

D. Roof penetration pieces or wall penetration shall be U.L. listed products of the chimney manufacturer and shall be suitable for a combustible roof or wall. All supports, roof or wall penetrations, terminations, roof curbs, adapters, thimbles, appliance connectors and drain fittings required to install the vent system shall be included. The vents shall be mounted on the roof or exterior wall with proper separations.

E. The piping and its supporting system shall resist side loads (horizontal and vertical) at least 1.5 times the weight per foot of the piping. Wall supports shall support (as verified by manufacturer testing) 40 feet of pipe with a factor of safety of at least four (4). Plate supports shall support (as verified by manufacturer testing) 200 feet of pipe in 6 inch through 20 inch ID sizes and 100 feet of pipe in 24 inch ID and larger sizes with a factor of safety of at least four (4).

F. The entire stack system from each boiler or appliance to the termination; including accessories, shall be from one manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The stack system shall be installed according to the manufacturer’s installation instructions and UL listing. Maintain minimum clearances from combustibles specified in UL listing.

B. Inner pipe joints shall be sealed as specified in the manufacturer’s installation instructions.

C. Install roof curbs for roof penetrations. Flashing of roof curbs are specified in other Sections.

D. Install manufacturer’s UL listed roof penetration piece and seal to penetration per manufacturer’s recommendations.

E. The system shall be installed as designed by the manufacturer and in accordance with the terms of the manufacturer’s ten (10) year warranty and in conjunction with sound engineering practice.

F. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain. Provided condensate trap and dilution tank before discharging the condensate to the drain as required.

G. Maintain 6" clearance between interior flue pipe and combustible materials including pipe and duct insulation.

H. Maintain 12" clearance between exterior flue pipe and combustible materials.

I. Provide stainless steel tubing at base clean out. Connect to condensing boiler and spill to nearest floor drain.

END OF SECTION 235101

SECTION 235216 CONDENSING BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes high-efficiency boilers for heating hot water.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-3(d).

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model indicated.

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

1.4 INFORMATION SUBMITTALS

A. Source Quality Control Tests and Inspection Reports: Indicate and interpret test results for compliance with performance requirements before shipping.

B. AGA design certificates, for information.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For condensing boilers to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For condensing boilers manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.

1. The Terms “Listed” and “Labeled”: As defined in NFPA 70, Article 100.

2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” as defined in OSHA Regulation 1910.7.

B. AGA Compliance: Design certified by AGA; tests and ratings according to AGA requirements.

C. ASME Compliance: Fabricate and label boilers to comply with the ASME Boiler and Pressure Vessel Code: Section VIII, “Pressure Vessels,” Division 1.

D. Comply with NFPA 70 for electrical components and installation.

1.7 QUALITY ASSURANCE SUBMITTALS

A. Manufacturer’s Certification Letter in accordance with NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section “Cast-in-Place Concrete.”

1.9 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Submit a written warranty, executed by the contractor for heat exchanger.

1. Warranty Period: Manufacturer’s standard, but not less than 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering boilers that may be incorporated into the Work include, but are not limited to, the following:

B. Basis of design manufacturer:

1. Sealed-Combustion Boilers:

a. AERCO International, Inc.

2.2 PACKAGED UNITS

A. Description: Factory-assembled and -tested fully condensing modules include combustion-air inlet chamber; prepurge and postpurge blower assembly; SA53 carbon steel pressure vessel with 4 inch flanged, 150 pound, ANSI rated water connection and inspection openings in accordance with ASME

Section IV pressure vessel code; full modulation air-gas fuel control valve; 316L stainless steel ASME stamped heat exchanger for a working pressure not less than 160 psig; corrosion resistant cast aluminum exhaust manifold with flue connection and collecting reservoir with gravity drain for elimination of condensation; burner capable of a 15-to-1 turndown ratio of the firing rate without loss of combustion efficiency, less than 30 ppm of NOx corrected to 3% excess oxygen, stainless steel construction for all material exposed to the combustion zone; insulated jacket around module; unit-mounted electrical control panel with operation sequence indicator lights; and condensate neutralizer tank. Single point power connection.

B. Fuel: Natural gas. (minimum gas pressure 14", maximum gas pressure 2psi).

2.3 CONTROLS

A. Controller: Solid state, with pressure-sensing flame safeguard system, ignition transformer, spark plug, manual gas shutoff valve, system-pressure-controlled regulator, automatic redundant control valves, high-limit water temperature controller, ASME-approved safety-relief valve, and temperature and pressure gage.

B. Operating Temperature Control: Manufacturer's Boiler Management System.

2.4 ACCESSORIES

A. Include the following list of manufacturer's standard accessories:

1. Low-water cutoff and manual-reset high-limit control.
2. Vent terminal plates.

B. Provide gas regulators to deliver pressure to boilers within manufacturer's operating range.

C. Manufacturer's Boiler Management System:

1. Provide a complete integrated boiler management system programmer to control all operation and energy input of the boiler heating plant. The boiler management system shall be comprised of a microprocessor based control to communicate with the boilers.

2. The controller shall have the ability to vary the firing rate and energy input of each individual boiler throughout its full modulating range to maximize the condensing capability and thermal efficiency output of the entire heating plant. The boiler management system shall control the boiler outlet header temperature within +2ºF, and shall provide contact closures for auxiliary equipment such as system pumps based upon outdoor air temperature.

3. Internal setpoint capability shall provide an adjustable temperature control setting from 50ºF to 190ºF. Indoor/Outdoor operation provides adjustable inverse ratio operation (0.3 to 3.0) in response to outdoor temperature to control the main header temperature. 4-20 ma signal operation will operate the plant to vary header temperature setpoint linearly as an externally applied 4-20 ma signal is supplied. Coordinate signal requirements to communicate with building controls system.

4. The controller shall have a display for monitoring of all sensors and interlocks. Non-volatile memory backup of all control parameters shall be internally provided as standard. The controller will automatically balance the sequence of operating time on each boiler by a first-on, first-off mode and provide for setback and remote alarm contacts.

2.5 SOURCE QUALITY CONTROL

A. Test and inspect boilers according to the ASME Boiler and Pressure Vessel Code, Section IV for low-pressure boilers. Inspection of Boilers is conducted by the State Bureau of Boilers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Detailed boiler manufacturer's combustion controls and safeguards info must be submitted to FM Global for review and comment prior to start of work. FM Global form 82, the installer's Checklist for Automatic Lighted Boiler Safety Combustion Control System, must be completed by the installing contractor and included with the combustion controls and safeguards submittal.

B. Examine area to receive boiler for compliance with requirements for installation tolerances and other conditions affecting boiler performance. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install boilers level and plumb, according to manufacturer's written instructions and referenced standards.

B. Install gas-fired boilers according to NFPA 54.

C. Support boilers on 6-inch- (100-mm-) thick concrete base, 4 inches (100 mm) larger on each side than base of unit.

D. Assemble units and parts shipped loose or disassembled.

E. Install electrical devices furnished with boiler, but not specified to be factory mounted.

3.3 CONNECTIONS

A. Connect gas piping full size to boiler gas-train inlet with union.

B. Connect air-intake and exhaust piping to boiler, size as recommended by manufacturer. Use Schedule 40 CPVC pipe and fittings for exhaust, PVC for supply, with solvent-cemented joints. Pitch toward boiler minimum of 2 percent or as indicated. Provide termination as indicated.

C. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

D. Electrical: Comply with applicable requirements in Division 26 Sections.

E. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to supervise the field assembly of components and installation of boilers, including piping and electrical connections. Report results in writing.

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Hydrostatically test assembled boiler and piping, according to applicable sections of the ASME Boiler and Pressure Vessel Code.

3.5 CLEANING

A. Flush and clean boilers on completion of installation, according to manufacturer's written instructions.

B. After completing boiler installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes including chips, scratches, and abrasions with manufacturer's touchup paint.

3.6 COMMISSIONING

A. Engage a factory-authorized service representative to provide startup service.

B. Verify that installation is as indicated and specified.

1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements specified in other Sections. Do not proceed with boiler startup until wiring installation is acceptable to equipment Installer.

C. Complete manufacturer's installation and startup checklist and verify the following:

1. Boiler is level on concrete base.

2. Flue and chimney are installed without visible damage.

3. No damage is visible to boiler jacket, refractory, or combustion chamber.

4. Pressure-reducing valves are checked for correct operation and specified relief pressure. Adjust as required.

5. Clearances have been provided and piping is flanged for easy removal and servicing.

6. Heating circuit pipes have been connected to correct ports.

7. Labels are clearly visible.

8. Boiler, burner, and flue are clean and free of construction debris.

9. Pressure and temperature gages are installed.

10. Control installations are completed.

D. Ensure pumps operate properly.

E. Check operation of pressure-reducing valve on gas train, including venting.

F. Check that fluid-level, flow-switch, and high-temperature interlocks are in place.

G. Start pumps and boilers, and adjust burners to maximum operating efficiency.

1. Fill out startup checklist and attach copy with Contractor Startup Report.

2. Check and record performance of factory-provided boiler protection devices and firing sequences.

3. Check and record performance of boiler fluid-level, flow-switch, and high-temperature interlocks.

4. Run-in boilers as recommended or required by manufacturer.

5. Measure and record gas pressure on manifold.

6. Measure and record combustion-air temperature at inlet to burner.

7. Measure and record flue-gas temperature at boiler discharge.

H. Measure and record water flow rate, pressure drops, and temperature rise through each boiler.

I. Inspect expansion tank, makeup water meter, tank pressure, pressure-reducing valve, water level, and backflow preventer.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:

1. Operate boiler, including accessories and controls, to demonstrate compliance with requirements.

2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

3. Review data in the maintenance manuals.

4. Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION 235216

SECTION 237200 AIR-TO-AIR ENERGY RECOVERY UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Packaged energy recovery units.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-3(d).

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS

B. Product Data for each energy recovery unit specified, including the following:

1. Certified supply and exhaust fans performance curves with system operating conditions indicated.

2. Certified fans sound power ratings.

3. Certified heat recovery component (i.e., heat exchangers, etc.) rated capacities for inlet and outlet operating conditions, and operating efficiencies indicated.

4. Certified coil-performance ratings with system operating conditions indicated.

5. Motor ratings and electrical characteristics plus motor and fan accessories.

6. Material gages and finishes.

7. Filters with performance characteristics.

8. Dampers, including housings, linkages, and operators.

9. Weights (shipping, installed, and operating).

10. Furnished specialties.

11. All required accessories.

12. Installation and startup instructions.

C. Shop Drawings: From manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring diagrams detailing wiring for power and control systems and differentiating between manufacturer-installed and field-installed wiring.

1.3 QUALITY ASSURANCE SUBMITTALS

A. Field test reports indicating and interpreting test results relative to compliance with specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For air-to-air energy recovery units to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For air-to-air energy recovery units specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with provisions of the following codes:

1. ASHRAE Compliance: Provide capacity ratings for energy recovery devices according to ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."

2. NRCA Compliance: Provide roof curbs for roof-mounted equipment constructed according to recommendations of NRCA.

B. Testing Requirements: The following factory tests are required:

1. Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

2. Fan Performance Ratings: For fans product data submitted, establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

C. NFPA Compliance: Central-station air-handling units and components shall be designed, fabricated, and installed in compliance with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

D. UL Standard: Provide units complying with UL 1812, "Ducted Heat Recovery Ventilators"; or UL 1815.

E. UL and NEMA Compliance: Provide ancillary electrical components, such as motors, required as part of energy recovery units that are listed and labeled by UL and that comply with applicable NEMA standards.

F. Comply with NFPA 70 for components and installation.

G. AHRI Compliance: Air to air energy recovery components shall comply with AHRI 1060.

H. ARI Compliance: Coils shall be rated in accordance with ARI standard 410 and bear the ARI seal.

I. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.

1. The Terms “Listed” and “Labeled”: As defined in the National Electrical Code, Article 100.

J. Coordination: Coordinate layout and installation of energy recovery units with piping and ductwork and with other installations.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver energy recovery unit as a factory-assembled module with protective crating and covering.

B. Lift and support units with manufacturer’s designated lifting or supporting points.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. .

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

B. Filters: Furnish one set of each type of filter specified.

C. Fan Belts: Furnish one set of belts for each belt-driven fan in energy recovery units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of design manufacturer: XETEX series XHR energy recovery rooftop units; XETEX Inc.

2.2 PACKAGED ENERGY RECOVERY UNITS (RTU-1 THRU RTU-10)

A. Double Wall Construction: Cabinet frame exterior and panels (fixed and access) shall be formed of minimum 18 gauge galvanized steel, primed with industrial universal primer, moisture and corrosion resistant, and acrylic top coat. Frame and panels to be double-walled construction with 2” thick insulation, 3# density hardboard, composed of glass fibers bonded with a thermoset resin and faced with an adhered black non-woven mat surface. Frame and panels to have an internal liner of minimum 22 gauge galvanized steel and shall be sealed with silicone sealant. Perforated panels shall be provided on the walls of all blower sections for acoustical insulation. Sloped roof panels with rain gutters shall overhang the sidewalls. Provide outside air shut-off damper, exhaust air shut-off damper, and intake and exhaust weather hoods with bird-screens. Outside air hoods shall be sized for 250 feet/minute velocity and configured to minimize capture of snow into rooftop unit.

1. Insulation shall have a thermal resistance R factor of 8.7 (2” thick). Insulation shall comply with ASTM 612, Type 1A and 1B. Per ASTM E 84 it shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50, and under NFPA 259 its limited combustible rating shall be less than or equal to 3,500 Btu/lb.

B. Structural Steel Base Frame and Floor: Unit shall have an all-welded base frame constructed from structural steel. The frame shall include formed supports constructed from welded structural steel under blowers and other components. A minimum 16 gauge galvanized steel interior floor shall be installed on the base frame. The floor shall be insulated with 2” thick load-bearing, rigid, closed-cell polyisofoam core insulation, with a minimum 22 gauge galvanized steel sub-floor under the insulation. All base frame seams shall be sealed and the frame shall be coated with a rust inhibiting paint. The perimeter of the frame shall be insulated.

1. Floor insulation shall comply with ASTM C1289, Type II, Class 1 and UL Classified; FM Class 1 Approved.

C. Drain Pans: 304 stainless steel, double sloped drain pans with all welded seams and MPT connections shall be provided in all heat exchanger sections. Heat exchanger sections shall have a minimum of two separate, full width, double sloped drain pans; one in the supply air plenum and one in the exhaust air plenum. Each drain pan shall be a minimum 3" deep with its own MPT drain. The heat exchanger shall be removable from the unit without requiring that the drain pans be removed or deconstructed.

D. Hinged Access Doors: Access to all exchanger surfaces, blowers, motors, filters, and other components requiring regular maintenance shall be provided through access doors. Access doors shall have double-wall construction with a minimum 18 gauge galvanized steel inner and outer walls, and 3# density hardboard fiberglass insulation. Access doors shall be held closed by a minimum of two roller cam latches. Door hinges shall be galvanized steel. Doors shall be removable from the unit frame. Access door frames shall be made from galvanized steel. Continuous hollow rubber gasket shall be applied to all access openings to provide water and airtight seals.

E. Air-to-Air Flat Plate Heat Exchangers: Air-to-air heat exchanger shall be aluminum, flat-plate type. Heat transfer surface shall be a minimum 0.008” thick formed aluminum plates. Heat exchanger frame profiles and corners shall be all aluminum. End plates shall be galvanized steel, capable of withstanding a pressure difference between airflows of up to 7.2" w.c. without deforming air passages. Unit shall be capable of operating in temperatures up to 190 degrees F. Cell construction shall have a maximum cross contamination between airflows of 0.1% of total airflow. The entire cell shall be capable of being visibly inspected and cleaned as required.

F. Plenum Blowers: Supply and exhaust air blowers shall be a backward inclined airfoil centrifugal plenum type without scroll housing arranged in a draw-through configuration. Fans shall incorporate a wheel; heavy gauge reinforced steel inlet plate shaft, and bearings in AMCA Arrangement 3 configuration to form a heavy-duty integral unit. Blowers shall be tested to AMCA standard 210 and bear the AMCA certified ratings seal for performance. The fan blades shall continuously welded, die-formed airfoil type, designed for maximum efficiency and quiet operation. Impellers shall be statically and dynamically balanced, non-overloading, and complete fan assembly shall be test balanced at the operating speed prior to shipment. Fan motors shall be premium efficient ODPT-frame. Motor and blower shall be mounted on common frame and isolated from unit case with restrained spring isolators with a minimum of 1" deflection flexible duct connections.

G. Coils: Coil shall be designed for use with a water-based heat transfer fluid containing 30 % propylene glycol. Complete coil core shall be tested with 315 pounds air pressure under warm water and guaranteed for 250 psig working pressures. Headers shall be of non-ferrous materials using seamless copper tubing with intruded tube holes to permit expansion and contraction without creating undue stress or strain.

H. Dampers: Parallel blade outside air dampers shall be mounted on the inlet of the unit and operated by a spring return, direct-coupled on-off actuator with an end switch to be interlocked with the supply air motor relay. Parallel blade exhaust air damper shall be mounted on the outlet of the unit and operated by a spring return, direct-coupled on-off actuator with an end switch to be interlocked with the return

air motor relay. Opposed blade face-and-bypass dampers shall be mounted flush to the face of the exchanger and operated by a spring return, direct-coupled, modulating proportional actuator. Dampers shall be interlocked so that when the face damper is open the bypass damper shall be closed.

1. Coordinate provision of controls and control devices with project controls contractor.

I. Filters: Outside and Return air filters shall be MERV 8 pleated panels consisting of cotton and synthetic media, media support grid and enclosing frame with integral channel for side-access application. Filters shall be mounted within unit in galvanized holding frames upstream of exchanger and accessible through access panels or doors.

J. Electrical: Electrical controls shall include variable frequency drives, fused branch circuit breakers, control transformer for low voltage controls, service switch, and terminal points/blocks all contained in a NEMA 3R, unit-mounted control panel. A single main disconnect switch for single point power connection shall be provided. The disconnect switch shall be mounted through the access panel so that power will have to be shut-off before the access door can be opened. The unit wiring diagram shall be provided in the panel. All provided wiring and controls shall be factory tested before shipment.

K. Manufacturer's Energy Recovery Control: The manufacturer's energy recovery control system shall use remote temperature sensors mounted in the entering and leaving sides of both airstreams to monitor exchanger performance. Setpoints shall be adjustable through the building control system.

1. The manufacturer provided controls shall prevent frost build-up. The controller shall monitor the temperature in the exhaust airstream leaving the exchanger and open the bypass side of the Face-and-Bypass damper enough to prevent the temperature from dropping below an adjustable, pre-programmed setpoint.

2. The manufacturer provided controls shall control heat recovery for economizer mode. The controller shall monitor the temperature of the supply air leaving the exchanger and open the bypass side of the Face-and-Bypass damper enough to prevent the temperature from rising above an adjustable, pre-programmed setpoint.

3. The manufacturer provided controls shall switch to maximum heat recovery for cooling mode. The controller shall monitor both indoor and outdoor temperatures. When outdoor temperature is higher than indoor temperature, the Face-and-Bypass damper shall open to full face mode.

4. Coordinate operation, adjustment and signal requirements with project controls contractor.

L. Variable Frequency Drives

1. VFD Certifications and Ratings: VFD's shall be UL listed as complete assemblies and be enclosed in enclosures that are UL listed as plenum rated. VFDs shall also have seismic certification. The tolerated voltage window shall allow the VFD to operate from a line of +30% to –35% of nominal voltage range. VFDs shall be rated for continuous operation to 104 °F with full current without being compromised by temperature variations within any 24 hour period; at 122 °F only 10% de-rating shall be required.

2. VFD Features: Drive-mounted digital displays and keypads shall allow operator interface. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs. Built in timers that use a real-time clock shall be included and eliminate the need for external timing circuits. VFDs shall have serial communication ports with BACnet MS/TP, Modbus, Johnson Controls N2, and Siemens Building Technologies FLN standard protocols and shall not require any third-party gateways. VFD shall have a programmable time delay for motor

start. VFDs shall also include Electromagnetic Interference / Radio Frequency Interference (EMI/RFI) filters that meet product standard EN 61800-3 for the First Environment and therefore eliminate the need for any external filtering hardware. VFDs shall have internal 5% impedance reactors to reduce the harmonics to the power line and to add protection for AC line transients. VFD shall transmit energy usage (kW and kWh) to the building controls system.

3. VFD Control Features: VFDs shall also incorporate two PID Set Point controllers allowing space pressure or flow signals to be connected to the VFD using the microprocessor in the VFD for closed-loop control. The second independent PID loop shall be capable of using an analog input to modulate an analog output to maintain the set point of an independent process (valve, damper, etc.). It shall be possible to monitor and control these processes through the serial communication port.

4. VFD Safety Features: VFDs shall provide a programmable loss-of-load relay/serial communication output to indicate a broken belt or coupling. A run permissive circuit shall delay motor operation until a dry contact has been closed indicating that the appropriate dampers are open. A minimum of two separate safety interlock inputs shall also be provided that, when opened, will cause the VFD to command the motor to stop and the damper to close.

M. Roof Curbs: Roof curb shall be minimum 16 gauge galvanized steel with additional supports and cross members as needed. Curb shall have wood nailer and 1.5" thick fiberglass insulation of the same type used to insulate the unit floor

N. Weights: Units shall not exceed the maximum weights listed below:

1. RTU-1 thru 6: 22,000 lbs
2. RTU-7: 25,000 lbs
3. RTU-8: 25,000 lbs
4. RTU-9: 14,000 lbs
5. RTU-10: 5,000 lbs

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive energy recovery units for compliance with requirements for installation tolerances and other conditions affecting performance of energy recovery units. Examine roughing-in of condensate drainage piping and electrical to verify actual locations of connections before installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Provide the services of the manufacturer’s factory-authorized service representative to instruct installing contractors on field assembly, system controls and devices, and provide startup services.

B. Install outdoor energy recovery units level and plumb, according to manufacturer’s written instructions.

1. Roof Mounted Units: Support roof mounted units on prefabricated roof curbs furnished by equipment manufacturer. Secure units to roof curbs per manufacturer’s installation instructions. Coordinate roof curb and curb flashing with roofing contractor. Ensure that roof curbs and units are watertight.

C. Arrange installation of units to provide access space around equipment for service and maintenance.

D. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.3 CONNECTIONS

A. Drawings indicate the general arrangement of ducts and duct accessories. Make final duct connections with flexible connections.

B. Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:

1. Install piping adjacent to unit to allow service and maintenance.

2. Connection piping to energy recovery units with flexible connectors.

3. Connect condensate drain pans using minimum 1-1/4-inch NPS (DN32), Type M copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

4. Hot Water Piping: Connect to supply and return coil tappings with shutoff or balancing valve and union or flange at each connection.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect and clean exposed finishes. Remove burrs, dirt and construction debris, and repair damaged finishes including chips, scratches and abrasions

B. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and heat recovery equipment air face areas.

3.5 COMMISSIONING

A. Manufacturer’s Field Inspection: Engage a factory-authorized service representative to perform the following:

1. Inspect field assembly of components and installation of equipment including piping, ductwork, and electrical connections.

2. Prepare a written report on findings and recommended corrective actions.

B. Final Checks before Startup: Perform the following before startup:

1. Verify that shipping, blocking, and bracing are removed.

2. Verify that unit is secure on curbs, mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify that proper thermal overload protection is installed in motors, starters and disconnects.

3. Perform cleaning and adjusting specified in this Section.

4. Disconnect heat recovery wheel drives from motors and verify heat recovery wheel rotation and smooth bearings operations. Reconnect wheel drive system, align belts, and install belt guards.

5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.

6. Set zone dampers to fully open position for each zone.

7. Set outside-air and return-air mixing dampers to minimum outside-air setting.

8. Inspect energy recovery component and confirm there is no damage or operational issues.

9. Install clean filters.

10. Verify that manual and automatic volume control, and any fire and smoke dampers in connected ductwork systems are in fully open position.

C. Startup Services: Engage a factory-authorized service representative to commission units as specified below.

1. Energize and verify correct rotation of heat wheels and fans.

2. Adjust seals and purge.

3. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

4. Prepare a written report on commissioning checklists and startup procedures.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

B. Review data in the operation and maintenance manuals.

C. Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION 237200

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes packaged rooftop heating and cooling units.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-3(d), 16a-38k-3(k).

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, required clearances, weights, furnished specialties and accessories; and installation and start-up instructions.

C. Shop Drawings:

1. Submit shop drawings detailing the manufacturer's electrical requirements for power supply wiring for rooftop heating and cooling units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

2. Submit shop drawings detailing the mounting, securing, and flashing of the roof curb to the roof structure. Indicate coordinating requirements with roof membrane system.

1.3 INFORMATION SUBMITTALS

A. Product certificates signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and products' compliance with specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of rooftop heating and cooling unit include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For each type of rooftop heating and cooling unit specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.5 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of rooftop heating and cooling units, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Regulatory Requirements:

1. Refrigerating system construction of rooftop units shall be in accordance with ASHRAE 15 “Safety Code for Mechanical Refrigeration.”

2. Energy Efficiency Ratio (EER) of rooftop units shall be equal to or greater than prescribed by ASHRAE 90.1 ““Energy Standard for Buildings except Low-Rise Residential Buildings.”

3. Rooftop units shall be listed by UL and have UL label as a unit.

1.6 SCHEDULING AND SEQUENCING

A. Coordinate installation of roof mounting curb as follows:

1. Furnish manufacturer’s standard roof curb for each piece of equipment.

2. Curb shall be installed and flashed by the Division 07 Contractor.

3. Installation of roof mounted equipment on the curb shall be by the Division 23 Contractor.

4. All flashing and roofing shall be by the Division 07 Contractor.

B. Coordinate roof opening with the Division 07 Contractor.

1.7 SPECIAL WARRANTY

A. Warranty on Compressors: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, compressors with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.

1. Warranty Period: 5 years from date of substantial completion.

1.8 MAINTENANCE

A. Extra Materials: Furnish to Owner, with receipt, the following spare parts for each rooftop heating and cooling unit:

1. One set filters for each unit.

PART 2 - PRODUCTS

2.1 ROOFTOP HEATING AND COOLING UNITS

A. Manufacturers: Subject to compliance with requirements, provide rooftop units of one of the following:

1. Aaon
2. Trane (The) Co; Div of American Standard Inc.
3. Daikin, McQuay.

B. General Description: Units shall be factory-assembled and tested, designed for roof installation, and consisting of compressors, condensers, evaporator coils, condenser and evaporator fans, refrigeration and temperature controls, filters, and dampers. Capacities and electrical characteristics are scheduled on the Drawings.

C. Casing: Manufacturer's standard casing construction, having corrosion protection coating, and exterior finish. Casings shall have removable panels or access doors for inspection and access to internal parts, a minimum of 1/2" thick thermal insulation, knockouts for electrical and piping connections and an exterior condensate drain connection and lifting lugs.

D. Roof Curbs: Factory fabricated, heavy gauge galvanized steel, 1 1/2" thick 18" high fiberglass insulated curb with solid bottom acoustic curb with spring isolated seismic restrained rail system. Curb shall be fabricated to match roof pitch. Provide supply and return duct flexible connector support hardware. Construction shall be in accordance with NRCA Standards. Provide 2" fiberglass isolation matt in bottom of curb. Provide flex pipe connections to unit..

E. Supply Fans:

1. Unit shall include direct drive, unhoused, backward curved, plenum supply fans.

2. Blowers and motors shall be dynamically balanced and mounted on rubber isolators.

3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.

4. Variable frequency drivers shall be factory wired, mounted in the units, and shall transmit energy usage (kW and kWh) to the building controls system; coordinate with controls contractor. Where multiple fans serve supply or exhaust airflow, a single variable frequency drive shall operate all fan motors. Fan motors shall be premium efficiency.

F. Exhaust Fans:

1. Exhaust dampers shall be sized for 100% relief.

2. Fans and motors shall be dynamically balanced.

3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.

4. Access to exhaust fans shall be through double wall, hinged access doors with quarter turn lockable handles.

5. Units hall include belt driven, unhoused, backward curved, plenum exhaust fans.

6. Variable frequency drives shall be factory wired, mounted in the unit, and shall transmit energy usage (kW and kWh) to the building controls system; coordinate with controls contractor. Where multiple fans serve supply or exhaust airflow, a single variable frequency drive shall operate all fan motors. Fan motors shall be premium efficiency.

G. Condenser Fans:

1. Propeller-type, direct-driven fans with permanently lubricated bearings.

H. Motors: Motors shall be Premium efficiency as manufactured by Baldor, Toshiba, or Reliance. Motors for use with VFD's are premium efficiency inverter rated only. Motor bearings are ball bearing and have external lubrication connections.

I. Coils:

1. General: Aluminum plate fin and seamless copper tube type. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Coils shall have a galvanized steel casing. Coils shall be mounted in the coil casing with same end connections accessible for service. Coils shall be removable from the unit through the roof or through the piping enclosure. Coil section shall be completely insulated.

2. Water heating coils: pitched in the unit casing for proper drainage.

a. Coils shall have metering orifices and a supply header to ensure distribution of hot water to each tube. Coils shall be proof (300 psig) and leak (200 psig) tested with air pressure under water.

3. Refrigerant cooling coils: have an equalizing type vertical distributor to ensure each coil circuit receives the same amount of refrigerant. Coils shall be proof (450 psig) and leak (300 psig) tested with air pressure under water, then cleaned, dehydrated, and sealed with a holding charge of nitrogen.

J. Compressors: serviceable, fully hermetic compressors, complete with integral vibration isolators and crankcase heaters.

K. Safety controls: manual reset type for:

1. Low pressure cutout;
2. High pressure cutout;
3. Compressor motor overload protection.

L. Economizer control: return and outside air dampers, outside air filter, fully modulating electric control system with enthalpy control, and adjustable mixed-air thermostat. System shall have 100 percent outside air capability. Provide automatic changeover through adjustable enthalpy control device.

M. Variable air volume control: discharge air step controller, and electric control system with enthalpy control.

N. Accessories: Units shall include the following accessories as indicated or scheduled:

1. Low ambient control: head pressure control, designed to operate at temperatures down to 0°F (-18°C).

2. Provide electrical disconnect switch sized per manufacturer.

O. Weights: Units shall not exceed the maximum weights listed below:

1. RTU-11: 2,200 lbs
2. RTU-12: 6,200 lbs

3. RTU-13: 6,200 lbs
4. RTU-14: 1,000 lbs
5. RTU-15: 1,000 lbs

2.2 ENERGY RECOVERY HEATING AND COOLING (RTU-11, RTU-12, RTU&-13)

A. Unit shall contain a factory mounted and tested energy recovery - wheel. The energy recovery wheel shall be mounted in a rigid frame containing the wheel drive motor, drive belt, wheel seals and bearings. Frames shall slide out for service and removal from the cabinet.

B. The energy recovery component shall incorporate a rotary when in an insulated cassette frame complete with seals, drive motor and drive belt.

C. Wheel(s) shall be wound continuously with one flat and one structured layer in an ideal parallel plate geometry providing laminar flow and minimum pressure drop-to-efficiency ratios. The layers shall be effectively captured in stainless steel wheel frames or aluminum and stainless steel segment frames that provide a rigid and self-supporting matrix.

D. Wheel(s) shall be provided with removable energy transfer matrix. Wheel frame construction shall be welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of tools to facilitate maintenance and cleaning. Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel and the wheel shall be connected to the shaft by means of taper locks.

E. All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belts of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.

F. The energy recovery cassette shall be an Underwriters Laboratories Recognized Component for electrical and fire safety. The wheel drive motor shall be an Underwriters Laboratory Recognized Component and shall be mounted in the cassette frame and supplied with a service connector or junction box. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, rating Air-to-Air Energy Recovery Ventilation Equipment. Cassettes shall be listed in the AHRI certified products.

G. Unit shall include 4 inch thick, pleated panel outside air filters with MERV rating of 8, upstream of the wheels.

H. Hinged service access doors shall allow access to the wheel(s).

I. Total energy recovery wheels shall be coated with silica gel desiccant permanently bonded by a process without the use of binders or adhesives, which may degrade desiccant performance. The substrate shall be lightweight polymer and shall not degrade nor require additional coatings for application in marine or coastal environments. Coated segments shall be washable with detergent or alkaline coil cleaner and water. Desiccant shall not dissolve not deliquesce in the presence of water or high humidity.

J. Unit shall include energy recovery wheel rotation detection sensors and a set of normally open and normally closed contracts for field indication of wheel rotation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which rooftop units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION

A. General: Install rooftop units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support: Installation of roof curbs shall be by the Division 07 Contractor.

C. Electrical Connections: Refer to Division 26 for final electrical connections to equipment and installation of loose shipped electrical components.

3.3 DEMONSTRATION

A. Start-Up Services:

1. Provide the services of a factory-authorized service representative to start-up rooftop units, in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Operating and Maintenance Training:

1. Provide services of manufacturer's service representative to instruct Owner's personnel in operation and maintenance of rooftop units. Training shall include start-up and shut-down, servicing and preventative maintenance schedule and procedures, and troubleshooting procedures plus procedures for obtaining repair parts and technical assistance. Review operating and maintenance data contained in the Operating and Maintenance Manuals.

a. Schedule training with Owner, provide at least 7-day prior notice to the Engineer.

END OF SECTION 237523

SECTION 238126 DUCTLESS SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for recessed ceiling or surface wall mounting.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-3(k).

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

C. Shop Drawings: Diagram power, signal, and control wiring, dimensional drawings, weights, and accessories.

1.4 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For split systems to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For split systems specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2007, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2007, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.7 COORDINATION

A. Coordinate size, location, and connection details with roof supports, equipment supports, and roof penetrations.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of design manufacturer:

1. Carrier Air Conditioning; Div. of Carrier Corporation.

2.2 CEILING RECESSED EVAPORATOR-FAN COMPONENTS

A. Chassis: High-strength molded plastic, removable panels for servicing.

1. Drain Pans: Polycarbonate plastic, with connection for drain; insulated.

2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.

C. Fan: Direct drive centrifugal; double inlet, forward curve.

1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.

D. Permanent, Cleanable Filters: ½ inch (25 mm) thick plastic screen.

E. Wiring Terminations: Connect motor to chassis wiring with plug connection.

F. Condensate Pump: Integral with unit.

G. Gyp Ceilings: Provide gyp ceiling framing as required for application. Provide ceiling access doors for unit service.

2.3 WALL SURFACE EVAPORATOR-FAN COMPONENTS

A. Chassis: High-strength molded plastic, removable panels for servicing.

1. Drain Pans: Polycarbonate plastic, with connection for drain; insulated.

2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.

C. Fan: Direct drive centrifugal; double inlet, forward curve.

1. Special Motor Features: Multi-tapped, multispeed with internal thermal protection and permanent lubrication.

D. Permanent, Cleanable Filters: 1/2 inch (25 mm) thick plastic screen.

E. Wiring Terminations: Connect motor to chassis wiring with plug connection.

F. Condensate Pump: Integral with unit.

2.4 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

A. Casing: Galvanized steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

1. Compressor Type: Scroll.

2. Inverter controlled compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.

3. Refrigerant: R-410A.

C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid sub-cooler.

D. Fan: Polycarbonate plastic-propeller type, directly connected to motor.

E. Motor: Permanently lubricated, with integral thermal-overload protection.

2.5 ACCESSORIES

A. Low ambient operation control kit: Permits operation down to 0°F.

B. Roof equipment rails (for condensing unit) 18 gauge galvanized steel; fully welded construction, internally reinforced with integral base plate and factory installed 2 by 4 wood nailer; fully mitered and welded corners; provide 3” cant beginning minimum of 1-1/2” above base plate of assembly and as required to match thickness of deck insulation; base plate pitch so as to maintain flat top; 20 gauge counterflashing. 18” high. .

C. Pipe penetration roof curbs, 18 gauge galvanized steel roof curbs with integral base plate, continuously welded corners for piping and conduit. Self-flashing without a cant strip, with mounting flange. Piping covers shall feature ABS thermoplastic UV and ozone resistant acrylic cover, graduated boots molded of weather-resistant, UV and ozone resistant rubber and (2) stainless steel pipe clamps per boot. 18” high.

D. AC and HPC Controls: Hard wired, 12 volt DC functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.

2. 24-hour time control of system stop and start.

3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.

4. Fan-speed selection, including auto setting.

5. Control adapter to allow unit to enable/disable through the Building Automation System.

E. Automatic-reset timer to prevent rapid cycling of compressor.

F. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction and liquid line with flared fittings at both ends.

1. Minimum Insulation Thickness: 1/2 inch (13 mm).

G. Fresh Air Intake and Power Ventilation Kits: Accessory collars power ventilation accessory, and baffles to permit introduction of fresh air into unit housing.

H. Integral Condensate pump with drain tubing capable of 12ft lift installed within evaporator unit on discharge side.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure. Where installed in gyp ceilings, provide access doors in ceiling to allow full service.

C. Install roof-mounting compressor-condenser components on equipment supports. Anchor units to supports with removable, cadmium-plated fasteners.

D. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

E. Connect condensate drain tubing from integral condensate pump discharge to termination point indicated.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to unit to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 238200 TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-3(k).

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 DESCRIPTION OF WORK

A. Extent of terminal unit work is indicated by drawings and schedules, and by requirements of this section.

B. Types of terminal units required for project include the following:

1. Finned Tube Radiation.
2. Unit Heaters.
3. Cabinet Unit Heaters.
4. Fan Coil Units.
5. Unit Ventilators.
6. Electric Heaters

C. Refer to other Sections for piping; ductwork; and testing, adjusting and balancing of terminal units; not work of this section.

D. Refer to other Sections for the following work; not work of this section.

1. Power supply wiring from power source to power connection on terminal unit. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

2. Interlock wiring between electrically-operated terminal units; and between terminal units and field-installed control devices.

a. Interlock wiring specified as factory-installed is work of this section.

E. Provide the following electrical work as work of this section. Complying with requirements of other Sections:

1. Control wiring, specified in other Sections, between field-installed controls, indicating devices, and terminal unit control panels.

1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of terminal units, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards:

1. I-B-R Compliance: Test and rate baseboard and finned tube radiation in accordance with I-B-R, provide published ratings bearing emblem of I-B-R.

2. ARI Compliance: Provide coil ratings in accordance with ARI Standard 410 “Forced-Circulation Air-Cooling and Air-Heating Coils.”

3. ASHRAE Compliance: Test coils in accordance with ASHRAE Standard 33 “Methods of Testing Forced Circulation Air Cooling and Heating Coils.”

4. ARI Compliance: Test and rate fan-coil units in accordance with ARI Standard 440 “Room Fan-Coil Air Conditioners.”

5. UL Compliance: Construct and install fan-coil units in compliance with UL 883 “Safety Standards for Fan Coil Units and Room Fan Heater Units.”

6. ARI Compliance: Test and rate unit ventilators in accordance with ARI Standard 330 “Unit Ventilators.”

7. UL Compliance: Provide electrical components for terminal units which have been listed and labeled by UL.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Submit manufacturer’s specifications for terminal units showing dimensions, capacities, ratings, performance characteristics, gages and finishes of materials, and installation instruction.

C. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, construction details, and field connection details.

D. Wiring Diagrams: Submit manufacturer’s electrical requirements for power supply wiring to terminal units. Submit manufacturer’s ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

1.5 INFORMATION SUBMITTALS

A. Product certificates signed by manufacturers of meters and gages certifying accuracies under specified operating conditions and products' compliance with specified requirements.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of terminal unit to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For each type of terminal unit specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handle terminal units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged terminal units or components; replace with new.

B. Store terminal units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with Manufacturer’s rigging and installation instructions for unloading terminal units, and moving them to final location.

PART 2 - PRODUCTS

2.1 FINNED TUBE RADIATION

A. General: Provide finned tube radiation of lengths and in locations as indicated, and of capacities, style, and having accessories as scheduled.

B. Cabinets: Minimum 18-ga cold-rolled steel full backplate, minimum 16-ga front. Brace and reinforce front minimum of 4'-0" o.c. without visible fasteners. Pedestal units provided with bar grilles.

C. Elements: Copper tube and aluminum fins, with tube mechanically expanded into fin collars to eliminate noise and ensure durability and performance at scheduled ratings.

D. Finish: Flat black heat resisting paint for backplate; factory-finished baked enamel, standard colors, on fronts and accessories.

E. Accessories:

1. End panels, inside and outside corners, and enclosure extensions.

2. Removable panels in front of valve assemblies.

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering finned tube radiation which may be incorporated in the work included, but are not limited to, the following:

1. Sterling Radiator; Mestek Inc.
2. Vulcan Radiator Co.
3. Rittling Radiator Co.

2.2 UNIT HEATERS

A. General: Provide unit heaters in locations as indicated, and of capacities, style, and having accessories as scheduled.

B. Horizontal Unit Heaters:

1. Casings: Construct of steel, phosphatized inside and out, and finished with baked enamel. Design casing to enclose fan, motor, and coil, design fan orifice formed into discharge panel. Provide air diffusers as scheduled.

2. Fans: Construct of aluminum and factory-balance. Design so motor and fan assembly is removable through fan outlet panel.

C. Coils: Construct of plate-type aluminum fins, mechanically bonded to copper tubes. Design coil for use in steam or hot water applications.

D. Motors: Provide totally enclosed motors, with built-in overload protection, having electrical characteristics as scheduled.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering unit heaters which may be incorporated in the work include, but are not limited to, the following:

F. Manufacturer: Subject to compliance with requirements, provide unit heaters of one of the following:

1. Sterline; Mestek Inc.
2. Modine Mfg. Co.
3. Trane (The) Co.

2.3 CABINET UNIT HEATERS

A. General: Provide cabinet unit heaters having cabinet sizes and in locations as indicated, and of capacities, style, and having accessories as scheduled. Include in basic unit chassis, coil, fanboard, fan wheels, housings, motor, and insulation.

B. Chassis: Galvanized steel wrap-around structural frame with edges flanged.

C. Insulation: Faced, heavy density glass fiber.

D. Cabinet: 16-ga removable front panel, 18-ga top and side panels. Insulate front panel over entire coil section. Provide access door on coil connection side. Clean cabinet parts, bonderize, phosphatize, and flow-coat with baked-on primer.

E. Water Coils: Construct of 5/8" seamless copper tubes mechanically bonded to configurated aluminum fins. Design for 300 psi and leak test at 300 psi under water. Provide same end connections for supply and return.

F. Fans: Provide centrifugal, forward curved double width fan wheels constructed of non-corrosive, molded fiberglass reinforced thermo-plastic material. Construct fan scrolls of galvanized steel.

G. Motors: Provide shaded pole motors with integral thermal overload protection, and motor cords for plug-in to junction box in unit.

H. Filters: Provide 1" thick throwaway type filters in fiberboard frames.

I. Accessories: Provide the following accessories as indicated and/or scheduled:

1. Recessing Flanges: Provide 18-ga steel flanges for recessing cabinet heaters into wall or ceiling.

2. Extended Oilers: Provide plastic motor oiler tubes extending to beneath top discharge grille.

J. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cabinet heaters which may be incorporated in the work include, but are not limited to, the following:

K. Manufacturers: Subject to compliance with requirements, provide cabinet unit heaters of one of the following:

1. Sterling

2. Trane (The) Co.

3. Modine Mfg. Co.

2.4 FAN COIL UNITS

A. General: Provide fan coil units having cabinet sizes, and in locations indicated, and of capacities, style, and having accessories as scheduled. Include in basic unit chassis, coils, drain pan assembly, fans, housing, motor, filter, and insulation.

B. Chassis: Construct chassis of galvanized steel with flanged edges.

C. Insulation: Faced, heavy density glass fiber.

D. Cabinet: Construct of 18-ga steel removable panels, 16-ga front. Provide insulation over entire coil section. Clean cabinet parts, bonderize, phosphatize, and flow-coat with baked-on primer.

E. Coils: Construct of 5/8" seamless copper tubes mechanically bonded to configurated aluminum fins. Design for 300 psi working pressure, and leak test at 300 psi under water.

F. Drain Pans: Construct of galvanized steel. Insulate with polystyrene or polyurethane insulation. Provide drain connection.

G. Fans: Provide centrifugal forward curved double width wheels of reinforced fiberglass, in galvanized steel fan scrolls.

H. Motors: Provide motors with integral thermal overload protection. Run test motors at factory in assembled unit prior to shipping. Provide quickly detachable motor cords.

I. Filters: Provide 1" thick throwaway type filters in fiberboard frames.

J. Dampers: Provide 18-ga steel damper blades with polyurethane stop across entire blade length. Provide factory-mounted electric operators for 25% open cycle.

K. Accessories: Provide the following accessories as indicated and/or scheduled:

1. Extended Oilers: Provide plastic motor oiler tubes extending to beneath top discharge grille.

2. Recessing Flanges: Provide 18-ga steel flanges for recessing fan-coil units into wall or ceiling.

L. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fan-coil units which may be incorporated in the work include, but are not limited to, the following:

M. Manufacturer: Subject to compliance with requirements, provide fan coil units of one of the following:

1. Carrier Corp.

2. International Environmental Corp.

3. McQuay Inc.

2.5 UNIT VENTILATORS

A. General: Provide unit ventilators having cabinet sizes, and in locations indicated, and of capacities, style, and having accessories as scheduled. Include in basic unit cabinets, dampers, fan board assembly, motors, and coils.

B. Cabinets: Construct of 14-ga furniture steel with exposed edges rounded. Provide removable front. Clean, phosphatize, and flow coat with baked primer paint steel surface. Finish with baked enamel, standard color as selected by Architect. Provide 12-ga demountable fan board assembly. Provide continuous heavy steel bars welded in place for discharge grilles, integral with unit structure. Provide completely removable end panels for access to piping and valves. Provide leveling legs. Provide pipe access openings in bottom of each end pocket, and pipe chase across back of unit for crossover piping and wiring.

C. Dampers: Provide dual-blade mixing dampers for modulation of return and outside air. Provide sealing device on damper edges and ends.

D. Fan Board Assembly: Provide assembly including fans, fan housings, bearings, and fan shaft. Mount fan assembly on rubber isolators.

E. Motors: Provide split-phase-start, capacitor-run constant speed motors.

F. Coils: Construct hydronic and steam coils of 5/8" copper tubes with plate-type aluminum fins.

G. Accessories: Provide the following accessories as indicated and/or specified:

1. Filters: Provide 1" thick throwaway filters in both outside and return air streams.

2. Wall Louvers: Provide wall louvers for outside air intake, vertical blade design, constructed of heavy gage aluminum.

3. Unit Shelving: Construct unit shelving of materials and finish to match cabinets. Provide adjustable channel reinforced shelves. For closed shelving units, provide roller hung doors with lock.

4. Crossover Piping: Provide in cabinet pipe chase, crossover piping of size and configuration as indicated on drawings.

5. Auxiliary Radiation: Provide finned tube radiation with enclosures to match unit ventilator cabinets.

H. Available Manufacturers: Subject to compliance with requirements, manufacturers offering unit ventilators which may be incorporated in the work include, but are not limited to, the following:

I. Manufacturer: Subject to compliance with requirements, provide unit ventilators of one of the following:

1. American Air Filter Co.

2. Daikin

3. Trane (The) Co.

2.6 ELECTRIC HEATERS

A. Casing shall be constructed of die-formed, heavy gage steel and finished in high gloss, baked enamel. The heater shall be designed to draw return air in through a stamped louver periphery and discharge through an outward drawn venturi. Provide adjustable discharge louvers to control direction of airflow, and a large hinged access door extending the width of the heater and locked in position by quarter turn fasteners. Provide wall/ceiling mounting hardware as available from the unit manufacturer.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which terminal units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF FINNED TUBE RADIATION

A. General: Install finned tube radiation as indicated, and in accordance with manufacturer’s installation instructions.

B. Locate finned tube radiation on outside walls as indicated, run cover wall-to-wall unless otherwise indicated.

C. Center elements under windows. Where multiple windows occur over units, divide element into equal segments centered under each window.

D. Install end caps where units butt against walls. Install access panels centered in front of each shutoff valve, balancing valve, air temperature control valve.

3.3 INSTALLATION OF UNIT HEATERS

A. General: Install unit heaters as indicated, and in accordance with manufacturer’s installation instructions.

B. Uncrate units and inspect for damage. Verify that nameplate data corresponds with unit designation.

C. Hang units from building substrate, not from piping. Mount as high as possible to maintain greatest headroom possible unless otherwise indicated.

D. Support units with rod-type hangers anchored to building substrate.

E. Install piping as indicated.

F. Protect units with protective covers during balance of construction.

3.4 INSTALLATION OF CABINET UNIT HEATERS

A. General: Install cabinet unit heaters as indicated, and in accordance with manufacturer’s installation instructions.

B. Locate cabinet heaters as indicated, coordinate with other trades to assure correct recess size for recessed units.

C. Install piping as indicated.

D. Protect units with protective covers during balance of construction.

3.5 INSTALLATION OF FAN COIL UNITS

A. General: Install fan-coil units as indicated, and in accordance with manufacturer’s installation instructions.

B. Locate fan coil units as indicated, coordinate with other trades to assure correct recess size for recessed units.

C. Install piping as indicated.

D. Protect units with protective covers during balance of construction.

3.6 INSTALLATION OF UNIT VENTILATORS

A. General: Install unit ventilators as indicated, and in accordance with manufacturer’s installation instructions.

B. Locate unit ventilators as indicated, level and shim units, anchor to substrate. Coordinate with other trades for exact location of wall louvers.

C. Install piping as indicated.

D. Protect units with protective covers during balance of construction.

3.7 INSTALLATION OF ELECTRIC HEATERS

A. General: Install terminal units as indicated, to comply with manufacturer's written instructions, NFPA 90A and National Electrical Code. Coordinate installation of terminal units with building

structure and architect. Provide all mounting accessories and access panels as required for unit maintenance.

3.8 ELECTRICAL WIRING

A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

B. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of other Sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

3.9 ADJUSTING AND CLEANING

A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.

B. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

C. Install new filter units for terminals requiring same.

END OF SECTION 238200

SECTION 238316 - HYDRONIC RADIANT FLOOR HEATING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5.

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 SCOPE

A. Each radiant floor heating system, per zone, shall include, but no limited to, all (PEX) tubing, piping, manifolds, valves, pumps, expansion tanks, pressure relief valves, slab sensors and controls to provide a complete and operational heating system. Each enclosure shall be pre-piped and wired.

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM) Standard ASTM F-876; Standard Specification for Cross-linked Polyethylene (PEX) Tubing.

B. American Society for Testing and Materials (ASTM) Standard ASTM F-877; Standard Specification for Cross-linked Polyethylene (PEX) Plastic Hot-and-Cold Water Distribution Systems.

C. Canadian Standards Association (CSA) Standard CAN/CSA B137.5; Cross-linked Polyethylene (PEX) Tubing Systems for Pressure Applications.

D. International Conference of Building Officials (ICBO) Evaluation Services; Evaluation Report No.4407.

E. Plastic Pipe Institute (PPI) Technical Report TR-3: Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials.

F. Plastic Pipe Institute (PPI) Technical Report TR-4: Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Piping and Fitting Compounds.

G. Housing and Urban Development (HUD): Material Release 1269

H. National Mechanical Code (BOCA).

I. Standard Mechanical Code (SBCCI).

J. Uniform Mechanical Code (ICBO).

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include product data including certified performance of system components indicating pump operating point, enclosure weights, furnished components and specialties, and accessories.

C. Shop Drawings: Showing dimensions and layout of enclosures packages.

D. Wiring Diagrams: Detailed wiring for power, signal, and control systems, differentiating between manufacturer-installed wiring and field-installed wiring.

E. Tubing Schedule: radiant floor tubing schedule that lists the manifolds and their respective loops. Tubing on center distances, flow rates per loop and identification for zones will also be included in the schedule information.

F. Manufactuer's Construction Drawings: For actual construction, installation drawings of the radiant floor design tubing layout to include all required detail notes to aid in the installation of the system shall be submitted for approval as specified under terms and condition of the Contract Document. No fabrication shall be performed until approval is obtained.

1.6 INFORMATION SUBMITTALS

B. Submit verification of Standard Grade Hydrostatic Design Stresses and Pressure Ratings on the PEX tubing from Plastic Pipe Institute in accordance with TR-3. The following standard grade ratings are required: 200□ F at 80 psi; 180□ F at 100 psi; 73.4□ F at 160 psi.

C. Submit third party verification that the PEX tubing manufacturing process is peroxide method (PEX-a). Acceptable third party agencies are: Hauser Laboratories, Boulder, Co.; Canadian Standards Association (CSA), Toronto, Ontario; National Sanitation Foundation (NSF), Ann Arbor, MI.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For radiant equipment to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For radiant equipment manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.8 QUALITY ASSURANCE

A. All components of the hydronic radiant floor heating distribution system shall be provided through one manufacturer including, but no limited to, tubing, fittings, manifolds, and other ancillary components required to complete the installation.

B. The installing contractor shall provide, in writing, to the project engineer that the PEX tubing furnished under this specification conforms to the material and mechanical requirements specified herein.

1.9 DELIVERY, STORAGE, AND HANDLING

A. All radiant floor heating system products shall be kept clean and dry during delivery and storage.

B. All PEX tubing shall be stored in its carton or under cover to avoid dirt or foreign material from being introduced into the tubing.

C. PEX tubing shall not be exposed to direct sunlight for more than 30 days during installation. If construction delays are encountered, the installing contractor is responsible to provide cover to all portions of the exposed tubing.

1.10 WARRANTY

A. PEX tubing shall carry a twenty-five (25) year non-prorated limited warranty against failure due to defects in quality or workmanship when installed by a licensed contractor.

PART 2 - PRODUCTS

2.1 TUBING

A. The peroxide method PEX (PEX-a) tubing is to be manufactured in accordance with ASTM F876.

B. Tubing shall not be manufactured using Siloxane material during the cross-linking process.

C. The PEX tubing shall be homogeneous throughout and essentially uniform in color, opacity, density and other properties. The inside and outside surfaces shall be matte or glossy in appearance. The tubing wall shall be free of cracks, holes, blisters, voids, foreign inclusions, or other defects that are apparent to the naked eye and that may affect the wall integrity.

D. Mild surface abrasions are acceptable. Gouges or notches in the tubing wall greater than 10% of the minimal wall thickness are not acceptable and are subject to rejection of that tubing loop (refer to ASTM F876 for additional information).

E. The tubing shall have an integral oxygen diffusion barrier applied at time of manufacturing that does not exceed an oxygen diffusion rate of 1.10 grams per cubic meter per day at 104E F water temperature in accordance with German DIN 4726.

F. The tubing shall be issued a Standard Grade Hydrostatic Design Stresses and Pressure Rating in accordance with all three temperatures and pressures listed in Table 1 of ASTM F876. Tubing shall be tested in accordance with PPI TR-3 and listed in PPI TR-4.

G. Tubing manufacturing process shall be certified by an ICBO approved independent third party testing laboratory and verification agency.

H. The PEX tubing shall be manufactured in the United States of America.

2.2 MANIFOLDS

A. Manifolds can be manufactured of High Density Polyethylene (HDPE), copper or brass material and shall be supplied by the respective tubing manufacturer for system compatibility.

B. Manifolds shall be constructed of HDPE material when a non-barrier PEX distribution tubing is used in the design. Copper or brass manifolds shall be installed when PEX distribution tubing with an oxygen diffusion barrier is used in the design.

C. HDPE manifolds must arrive from the PEX tubing manufacturer with fittings installed on the outlet nipples of the manifolds. Copper manifolds will have fittings sweated on the outlet nipples of the manifolds.

D. Each manifold location shall have the ability to vent air manually from the system when installed at a higher elevation than the radiant panel area.

E. Manifolds installed above ground shall be isolated from supply and return piping with valves that are suitable for isolation and balancing.

2.3 FITTINGS

A. Fittings to attach the PEX tubing to the manifold shall be supplied by the tubing manufacturer.

B. The fitting shall consist of a PEX ring marked to the respective tube size and the applicable fitting.

C. All fittings installed on HDPE manifolds are to be machined from 303 stainless steel material. All fittings installed on copper manifolds are to be machined from 360 brass material.

D. All fittings used as splice connections shall be of suitable material and in accordance with the manufacturer's recommendations.

E. Fittings shall be certified to comply with the requirements of ASTM F877.

F. The fittings shall be manufactured in the United States of America.

2.4 SUPPLY AND RETURN PIPING TO MANIFOLDS

A. Provide piping per Section 230060 - HVAC Piping.

2.5 RADIANT FLOOR HEATING ENCLOSURES

A. Manufacturer's wall mounted lockable enclosures, each containing pre-piped manifolds, pump, 3-way mixing valve and pipe main shutoff valves. Provide suitable space for mounting controls devices provided by controls contractor. Provide skirt below enclosures (mounted 18" above floor) to conceal tubing.

1. Enclosures RZ-1,2 & 3 shall contain pump and 3-way mixing valve with connections to pipe mains and pre-insulated piping routed to manifolds in Maintenance Pits. Lockable Maintenance Pit enclosures shall contain manifolds with pre-insulated piping shutoff valves and capped drain valves with hose end connections within recesses. Coordinate enclosure dimensions with pit wall recesses. There shall be no electronic devices within pit enclosures.

PART 3 - INSTALLATION

3.1 GENERAL

A. During the installation, all tubing shall be capped on each end to prevent foreign materials from entering the tubing.

B. All tubing shall be checked for abrasions prior to installation. Tubing embedded in the slab shall be installed without joints or splices unless authorized by the tubing manufacturer.

C. The tubing shall be installed in such a manner as to effectively address the heat loss of the space. Tubing shall not be placed near heat sensitive materials.

D. PEX tubing shall be properly pressure tested, in accordance with the tubing manufacturer's guidelines, prior to burial of the tubing in concrete. The tubing system shall maintain an air pressure test, under a minimum pressure of 80 psi, for a period of twenty-four (24) hours prior to the concrete pour. Tubing shall be pressured prior to and during the concrete pour to ensure system integrity.

E. All pressure tests shall be accomplished with air pressure. If the installing contractor prefers the use of water for pressure testing, then the installing contractor is responsible for the removal of all water from the system if ambient air temperatures approach 32E F or less. If freezing temperatures are likely, then the system shall be pressurized with air only.

F. After the system has been filled, air shall be vented from the system. Provisions should be made for components in the mechanical room to allow system purging of air.

G. Mount bottom of enclosures 18" above finished floor.

3.2 CONCRETE SLAB ON GRADE INSTALLATION

A. The tubing shall be fastened to the flat mesh or reinforcing bar in accordance with the tubing manufacturer's installation recommendations.

B. Tubing on center distance(s) and loop lengths shall be specified in the submitted radiant floor design tubing layout.

C. Tubing will be installed no closer than six (6) inches from all walls.

D. If under slab insulation is required by the design, the vertical compressive strength of the high density extruded board insulation will be determined by the Architect. Required insulation resistance value ® value) to be determined by the radiant floor design.

E. Tubing shall be installed at a consistent depth below the surface elevation as determined by the project engineer. Tubing installation will ensure sufficient clearance of all control joint cuts.

F. In areas where tubing must cross metal expansion joint that occur in the concrete; the tubing shall be installed below the metal expansion joints. Fibrous expansion joints may be penetrated depending on the tubing manufacturer's and Architect's recommendations. Provide PVC sleeves crossing expansion joints per manufactuer's instructions.

G. Metal or PVC bend supports will be used to support the tubing departing from the slab at a 90E bend.

END OF SECTION 238316

SECTION 260500 (OPS) - COMMON WORK RESULTS FOR ELECTRICAL (OFF-SITE PUMP STATION NO.2)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, and wireways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - NOT APPLICABLE

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

END OF SECTION 260500 (OPS)

SECTION 260500 BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Section Includes: Basic administrative and procedural requirements, and general requirements for electrical products and installation applicable to all Division 26 work.

C. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13. for credits 16a-38k-4(b(4, 16a-38k-4(b)5

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 SCOPE OF WORK

A. Provide all labor, materials, tools, equipment, transportation and services necessary for and incidental to completion of all electrical work as indicated on the Drawings and/or as specified herein.

1.4 DRAWING USE AND INTERPRETATION

A. The Drawings are diagrammatic and indicate the general arrangement of systems and equipment unless indicated otherwise by dimensions or details. Install work substantially as indicated. Exact equipment locations and raceway routing, etc. shall be governed by actual field conditions and/or instructions of the Engineer and/or Owner's Representative.

1.5 COMPLETE SYSTEMS

A. General: Furnish and install all materials as required for complete systems, including all parts obviously or reasonably incidental to a complete installation, whether specifically indicated or not. All systems shall be completely assembled, tested, adjusted and demonstrated to be ready for operation prior to Owner's acceptance.

B. Wiring: The wiring specified and/or shown on the Drawings is for complete and workable systems. Any deviations from the wiring shown due to a particular manufacturer's or subcontractor's requirements shall be made at no cost to either the Contract or the Owner.

1.6 CODES AND REGULATIONS

A. General: Comply with the National Electrical Code (NEC) and all governing federal, state, and local laws, ordinances, codes, rules, and regulations. Where the Contract Documents exceed these requirements, the Contract Documents shall govern. In no case shall work be installed contrary to or below minimum legal standards.

B. Utilities: Comply with all applicable rules, restrictions, and requirements of the utility companies serving the project site/facilities.

C. Non-Compliance: Should any work be performed which is found not to comply with any of the above codes and regulations, provide all work and pay all costs necessary to correct the deficiencies.

1.7 REFERENCE STANDARDS

A. All latest published standards of the following associations/organizations shall be followed and applied where applicable, as minimum requirements:

1. (ADA) Americans with Disabilities Act.
2. (ANSI) American National Standards Institute.
3. (ASTM) American Society for Testing and Materials.
4. (BOCA) Building Officials and Code Administrators International, Inc.
5. (CBM) Certified Ballast Manufacturer.
6. (ETL) Electrical Testing Laboratory.
7. (EPACT) National Energy Policy Act of 1992.
8. (ICEA) Insulated Cable Engineers Association.
9. (IEEE) Institute of Electrical and Electronic Engineers.
10. (IESNA) Illuminating Engineering Society of North America.
11. (NBFU) National Board of Fire Underwriters.
12. (NEMA) National Electrical Manufacturers Association.
13. (NESC) National Electric Safety Code.
14. (NFPA) National Fire Protection Association.
15. (UL) Underwriter's Laboratories.
16. (IBC) International Building Code.

1.8 PERMITS

A. General: Obtain and pay for any and all permits required by all applicable agencies, prior to commencing work.

1.9 QUALITY ASSURANCE

A. Manufacturers' Qualifications: Not less than three years experience in the actual production of the specified products.

B. Installers' Qualifications: Firm with not less than five years experience in the installation of electrical systems and equipment similar in scope and complexity to those required for this Project, and having successfully completed at least ten comparable scale projects.

C. Incidental Work: Painting, patching, welding, carpentry and the like related to or required for Division 26 work shall be performed by craftsman skilled in the appropriate trade, but shall be provided for under Division 26.

1.10 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.11 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.12 INSPECTIONS

A. General: During and upon completion of the work, arrange and pay all associated costs for inspections of all electrical work installed under this contract, in accordance with the Conditions of the Contract.

B. Inspections Required: As per the laws and regulations of the local and/or state agencies having jurisdiction at the project site.

C. Inspection Agency: Approved by the local and/or state agencies having jurisdiction at the project site.

D. Certificates: Submit all required inspection certificates.

PART 2 - PRODUCTS

2.1 GENERAL

A. Where Specified: Materials and equipment shall be as specified in subsequent sections of the Project Manual and/or as indicated on the Drawings.

B. General Requirements: All materials and equipment shall be in accordance with the Contract Documents, and to the extent possible, standard products of the various manufacturers, except where special construction or performance features are called for. All materials and equipment to be new, clean, undamaged, and free of defects and corrosion.

C. Acceptable Products: The product of a specified or approved manufacturer will be acceptable only when that product complies with or is modified as necessary to comply with all requirements of the Contract Documents.

D. Common Items: Where more than one of any specific item is required, all shall be of the same type and manufacturer.

E. UL Listing: All electrical materials and equipment shall be Underwriters' Laboratories (UL) listed and labeled, where UL standards and listings exist for such materials or equipment.

2.2 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to the Conditions of the Contract, and Division 1.

PART 3 - EXECUTION

3.1 GENERAL

A. The installation of all electrical work shall be in accordance with the letter and intent of the Contract Documents, as determined by the Engineer.

B. Installation Requirements: All materials and equipment shall be installed as recommended by the respective manufacturers, by mechanics experienced and skilled in their particular trade, in a neat and workmanlike manner, in accordance with the standards of the trade, and so as not to void any warranty or UL listing.

C. Administration and Supervision: All electrical work shall be performed under the Contractor's direct supervision, using sufficient and qualified personnel as necessary to complete the work in accordance with the progress schedule. The Contractor shall assign one or more competent supervisors who shall have authority to accept and execute orders and instructions, and who shall cooperate with the other Contractors and subcontractors, the Engineer and Owner in all matters to resolve conflicts and avoid delays.

3.2 DELIVERY STORAGE AND HANDLING

A. Comply with Division 1 requirements.

B. Packing and Shipping: Deliver products in original, unopened packaging, properly identified with manufacturer's identification, and compliance labels.

C. Storage and Protection: Comply with all manufacturer's written recommendations. Store all products in a manner which shall protect them from damage, weather, and entry of debris.

D. Damaged Products: Do not install damaged products. Arrange for prompt replacement.

3.3 EXAMINATION

A. Conditions Verification: Examine the areas and conditions under which the work is to be performed, and identify any conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

3.4 COORDINATION

A. General: Sequence, coordinate and integrate the installation of all electrical materials and equipment for efficient flow of work, in conjunction with the other trades. Review the Drawings for work of the other trades, and report and resolve any discovered discrepancies, prior to commencing work.

B. Cooperation: Cooperate with the other Contractors and individual disciplines for placement, anchorage and accomplishment of the work. Resolve interferences between work of other disciplines or Contractors, prior to commencing installation.

C. Chases, Slots, and Openings: Arrange for chases, slots, and openings during the progress of construction, as required to allow for installation of the electrical work.

D. Supports and Sleeves: Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

E. Obstacles and Interferences: When installing equipment and raceways, provide offsets, fittings, accessories and changes in elevation or location as necessary to avoid obstacles and interferences, per actual field conditions.

3.5 DIMENSIONS

A. Building Dimensions: For exact locations of building elements, refer to dimensioned drawings. However, field measurements take precedence over dimensioned drawings.

B. Limiting Dimensions: Equipment outlines shown on detail drawings of 1/4" = 1'-0" scale or larger and dimensions indicated on the Drawings are limiting dimensions. Do not install equipment exceeding dimensions indicated by outlines on Drawings, or equipment or arrangements that reduce indicated clearances.

3.6 EQUIPMENT PROTECTION

A. Protect all electrical equipment, and materials and work from the weather elements, paint, mortar, construction debris and damage, until project is substantially complete. Repair, replace, clean all electrical work so affected.

3.7 CHECKOUT, TESTING, AND ADJUSTING

A. General: Schedule and provide testing equipment, materials, instruments, and personnel as necessary to checkout and to perform all test procedures and adjustments required by the Contract Documents and/or deemed necessary by the Engineer to establish proper performance and installation of electrical systems and equipment. All test instruments to be accurately calibrated and in good working order.

B. Scheduling: Schedule tests at least three days in advance, and so as to allow Engineer and Owner representative(s) to witness the test, unless directed otherwise. Do not schedule tests until the system installation is complete and fully operational, unless indicated or directed otherwise.

C. Manufacturer's Authorized Representatives: When required by subsequent Division 16 specification sections, arrange and pay for the services of the manufacturer's authorized representative(s) to be present at time of equipment or system start-up, to supervise the start-up, and to conduct and/or certify all required testing and adjusting.

D. Test Reports: Submit test reports neatly typewritten on 8-1/2 x 11" sheets indicating system or equipment being tested, methodology of testing, date, and time of test, witnesses of test, and test results. Submit test reports in (3) copies to the Engineer for review, within (5) days after test is performed, and include a copy with the appropriate operation and maintenance data.

E. Correction/Replacement: After testing, correct any deficiencies, and replace materials and equipment shown to be defective or unable to perform at design or rated capacity. Retest without additional cost to the Owner or Contract. Submit finalization report indicating corrective measures taken, and satisfactory results of retest.

3.8 SYSTEMS DEMONSTRATION

A. Instruct the Owner's representative(s) in the start-up, operation and maintenance of all electrical systems and equipment in accordance with Division 1, as required by subsequent sections, and as requested by the Owner's Representative.

3.9 CLEANING AND TOUCH-UP PAINTING

A. Perform cleaning required by Division 1.

B. General: Periodically remove from the project site, all waste, rubbish and construction debris accumulated from construction operations, and maintain order. The premises shall be left clean and free of any debris and unused construction materials, prior to final acceptance.

C. Electrical Equipment: Remove all dust, dirt, debris, mortar, wire scraps, rust, and other foreign materials from the interior and exterior of all electrical equipment and enclosures, and wipe down. Clean accessible current carrying elements and insulators prior to energizing.

D. Light Fixtures: Thoroughly clean all light fixtures and lamps, just prior to final inspection. Fixture enclosures, reflectors, lenses, etc. shall be cleaned free of dust, dirt, fingerprints, etc. by an approved method.

E. Touch-Up Painting: Restore and refinish to original condition, all surfaces of electrical equipment scratched, marred and/or dented during shipping, handling, or installation. Remove all rust, and prime and paint as recommended by the manufacturer.

END OF SECTION 260500

SECTION 260501 BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Section Includes: General requirements, and basic electrical materials and methods applicable to all Division 26 work. Limited scope general construction materials and methods for application with electrical installations are also included.

C. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13.

2. HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.4 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.5 COORDINATION

A. Chases, slots, inserts, sleeves and openings: Coordinate with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.

PART 2 - PRODUCTS

2.1 PIPE SLEEVES

A. Rigid steel conduit or iron pipe.

2.2 CONDUIT SEALS

A. For Cast-in-Place Concrete Applications: Acceptable Manufacturers: O-Z/Gedney Type “FSK”; Thunderline Corp. “Link Seal” with “ Link Seal Wall Sleeve.”

B. For Core Drilled and Pre-cast Opening Applications: Acceptable Manufacturers: O-Z/Gedney Type “CSML”; Thunderline corp. “Link Seal.”

2.3 FIRESTOPPING MATERIALS

A. General: Firestop systems composed of firestop compounds and appropriate damming materials installed together with the penetrant (e.g., conduit) to form a complete firestop system, providing a fire resistant rating at least equal to the hourly fire resistance rating of the floor, wall or partition into which the firestop system is to be installed.

B. Test Standards: Firestopping materials shall be tested together as a system to the time/temperature requirements of ASTM E119 and shall be tested to UL 1479 (ASTM E814) and be UL classified for up to 3 hours.

C. Firestop Sealants: Non-hardening, conformable, intumescent putties, sealants or other compounds, containing no toxic solvents or asbestos, and exhibiting aggressive adhesion to all common building materials and penetrants, while allowing reasonable movement of the penetrants, without being displaced. Compounds shall be waterproof, non-toxic and smoke and gas tight.

D. Firestop Mortars: Light-weight, water-based, cementatious, fast drying, low density mortar, non-shrinking and non-cracking during its cure, and which forms a surface capable of being sanded, bored and painted.

E. Damming Materials: Mineral wool or ceramic fiber.

F. Multi-Cable Transits: Assemblies consisting of a frame, a compression mechanism, and grooved insert sealing modules sized for multiple penetrating elements of various sizes.

G. Acceptable Manufacturers: Dow Corning; Heavy Duty/Nelson; International Protective Coatings; Specified Technologies, Inc.

2.4 SOIL MATERIALS

A. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, or natural or crushed sand.

B. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2 inch sieve, and not more than 5 percent passing a No. 4 sieve.

C. Backfill and Fill Materials: Materials complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP, free of clay, rock, or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetable, and other deleterious matter.

2.5 CONCRETE WORK

A. Concrete:

1. Strength: 3000 psi (20.7 - MPa@ 28 days (compressive strength), Pads 2500 psi (17.3 - MPa) @ 28 days (trench)
2. Aggregate: 3/4" aggregate
3. Cement: 588 #/cu. yd. minimum, type I or II

4. Slump: 4" maximum
5. Air: 5% - 7%

B. Reinforcing: Grade 60 bars, sized as indicated, and 6" x 6" - W1.4 x W1.4 mesh, and other reinforcing as indicated.

C. Forms: Wood, metal or other approved materials, constructed so as to withstand the forces of the newly placed concrete.

D. Equipment Pads: Minimum 3-1/2" thick indoor, 12" thick outdoor (with 9" below grade), with 1" x 45º chamfer on all top edges. For on grade installations provide 12" layer of crushed stone beneath pad. For pads to be placed on concrete floors, provide anchors into concrete floor.

2.6 TOUCH UP PAINT

A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.

B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

PART 3 - EXECUTION

3.1 ELECTRICAL INSTALLATION - GENERAL

A. Unfinished and Finished Areas: For the purposes of these electrical specifications, "unfinished" areas shall include mechanical, electrical, telephone equipment rooms and garage areas. All other areas shall be considered "finished" spaces, unless indicated or approved otherwise.

B. In Unfinished Areas: Raceways, equipment and devices may be installed, concealed or exposed, unless indicated otherwise.

C. In Finished Areas: Conceal all raceway and flush mount all electrical boxes, equipment, and devices unless indicated or approved otherwise. The space above suspended ceilings or behind furred spaces is considered outside finished areas and electrical materials installed within these areas are considered concealed.

D. Headroom: Arrange and install components and equipment to provide the maximum possible headroom, unless otherwise indicated.

E. Dimensions and Clearances: Field measure all dimensions and clearances affecting the installation of electrical work, in relation to established datum, building openings and clearances, and work of other trades, as construction progresses.

F. Rough-In Locations: Verify final locations for rough-ins with field measurements and requirements of actual equipment being installed.

G. Door Swings: Verify the swings of all doors before switch outlets or other electrical devices are installed. If necessary, relocate devices so they are not obstructed by doors when doors are open.

H. Ceiling Mounted Devices: The locations indicated on the architectural reflected ceiling plans take precedence over the electrical documents, in the event of conflict.

3.2 LAYOUT

A. General: Install electrical systems, materials and equipment level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.

B. Serviceability: Install electrical equipment and raceways, etc. to readily facilitate servicing, maintenance and repair or replacement of components, and so as to minimize interference with other equipment and installations.

C. Clearances: Prior to commencing work, verify that all electrical equipment will adequately fit and conform to the indicated and code required clearances, in the spaces indicated on the Drawings. If rearrangement is required, submit plan and elevation drawings or sketches indicating proposed rearrangement, for the Engineer's approval. Do not rearrange without express written permission of the Engineer.

D. Right-Of-Way: When laying out electrical work, give priority in available space to steam and condensate lines, sanitary lines, drain lines, fire protection piping and sheet metal duct work. Provide offsets as required to avoid conflicts. Resolve all conflicts before commencing installation.

3.3 MOUNTING HEIGHTS

A. General: Indicated heights are measured from the center of the device outlet box to finished floor or grade, unless indicated otherwise. Request instructions for mounting heights not indicated.

B. Architectural Elevations: Heights and locations for outlets and equipment in specific areas when indicated on architectural elevations take precedence over mounting heights and locations indicated in electrical documents. If outlets and equipment are not indicated on the architectural elevations, the electrical documents govern.

C. Adjustments: Adjust mounting heights in exposed masonry construction so that bottoms of outlet boxes are along the edges of blocks, unless indicated otherwise.

3.4 HOLES, SLEEVES, AND OPENINGS

A. General: Provide all holes, sleeves, and openings required for the completion of Division 16 work and restore all surfaces damaged, to match surrounding surfaces. Maintain integrity of all fire and smoke rated barriers using approved firestopping systems. When cutting holes or openings, or installing sleeves, do not cut, damage or disturb structural elements or reinforcing steel, unless approved, in writing, by the Project Structural Engineer.

B. Conduit Penetrations: Size core drilled holes so that an annular space of not less than 1/4" and not more than 1" is left around the conduit. When openings are cut in lieu of core drilled, provide sleeve in rough opening. Size sleeves to provide and annular space of not less than 1/4" and not more than 1" around the conduit. Patch around sleeve to match surrounding surfaces.

3.5 CONDUIT SEALS

A. Install conduit seal for each conduit penetrating an exterior building wall below grade (unless penetration is below lowest building floor slab), and elsewhere as indicated, and so as to achieve a sealed watertight installation.

B. Install conduit seal for each conduit passing from a heated building to a non-heated building and vice versa.

C. Install conduit seal for each conduit passing from a hazardous location to a non-hazardous location and vice versa.

3.6 FIRESTOPPING SYSTEMS

A. General: Install firestopping at all electrical raceway and cable penetrations through floor structures and interior walls or partitions which are time-rated fire and/or smoke barriers.

B. Preparation: Prior to installation, verify that all penetrating elements and supporting devices are permanently installed and that surfaces which will be in contact with penetration seal materials are clean and free of dust, dirt, grease, oil, loose materials, rust or other substances.

C. Installation: Install firestop systems in accordance with UL approved design details and the manufacturer's instructions. Install sleeves, conduits and cables with required clearance spaces, allowing installation of sealing materials. Do not exceed the outside diameter of the sleeve, conduit or cable by more than one inch or by less than 1/4" when making openings for penetrations. Install firestop systems so as to completely seal openings to prevent passage of smoke and water.

3.7 CUTTING AND PATCHING

A. General: Provide all cutting, drilling, chasing, fitting and patching necessary for accomplishing the work of Division 26. This includes any and all work necessary to: uncover work to provide for the installation of ill-timed work; remove and replace defective work and work not conforming to the requirements of the Contract Documents; install equipment and materials in existing structures; in addition to that required during the normal course of construction.

B. Comply with the cutting and patching requirements of Division 1.

C. Building Structure: Do not endanger the integrity of the building structure by cutting, drilling or otherwise modifying any structural member, without specific approval. Do not proceed with any structural modifications without written permission of the Project Structural Engineer.

D. Repairs: Repair any and all damage to work of other trades caused by cutting and patching operations, using skilled mechanics of the trades involved.

3.8 WELDING

A. General: Where welding is required, such welding shall be performed in a skilled manner by certified welders. Verify that welds are free from cracks, craters, undercuts, and strikes, weld spatter, and any other surface defects. Clean and re-weld any welds deemed unacceptable in size or configuration. Do not weld to structural steel without prior written permission from the Project Structural Engineer.

3.9 UNDERGROUND ELECTRICAL WORK

A. General: Perform all excavating, trenching and backfilling, etc. as indicated or required for the installation of all underground electrical work. Coordinate work with other trades and verify existing underground services and conditions.

B. Conduit Burial Depth: 30" below finished grade, unless indicated otherwise. All excavation and burial depths indicated are below finished grade.

C. Excavating: Do not excavate below required depth, except as necessary for removal of unstable soil or when rock is encountered. When rock is encountered, excavate six inches below the required depth and backfill with a minimum 6" layer of crushed stone or gravel between rock bearing surface and the electrical installation. Stockpile satisfactory excavated materials where directed, until required for backfilling. Remove and legally dispose of excess excavated materials and materials not suitable for backfill use. Shore and brace as required for stability of excavation. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting off at an elevation of 30" below finished grade.

D. Protection: Protect structures, utilities, sidewalks, pavements and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by excavations.

E. Existing Utilities: Remove existing electrical and other utility lines so indicated. Where existing utilities which are to remain exist within areas of excavation, locate such utilities and support and protect during excavation operations.

F. Trenching: Cut all trenches neatly and uniformly and so as to provide ample working room and at least six inches clearance on both sides of raceways, etc. Take necessary precautions when working near existing underground utilities, and coordinate with the installation of concurrent utilities by other trades. Unless indicated otherwise, pitch all electrical conduit runs downward away from buildings, manholes, and pad mounted equipment. Excavate trenches to depth indicated or required. Limit length of open trench to that in which installations can be made and trenches backfilled within the same day.

G. Sand Envelope: Install a minimum envelope of three inches (top, bottom, and sides: three inches each) of fine grain sand around all electrical cables and conduits installed below grade unless indicated otherwise.

H. Preparation for Backfilling: Backfill excavations as promptly as work permits, but not until completion of inspection, testing, approvals, and recording of underground utility locations. Prior to backfilling, remove all concrete form work, shoring, bracing, trash and debris.

I. Backfilling: Use only approved materials free from boulders, sharp objects and other unsuitable materials. Match the final elevations and materials of areas affected by electrical excavating, trenching and backfilling. Replace conduit and cables damaged by improper backfilling. Replace surface materials to match existing surface materials if no other utility or site work is being done in area. Place specified soil materials in 4" - 8" layers to required subgrade elevations, for area classifications as follows:

1. Under Sidewalks and Pavements: Use combination of subbase materials and excavated or borrowed materials.

2. Under Building Slabs: Use drainage fill materials.

3. Under Piping and Equipment: Use subbase materials where required over rock bearing surfaces and for correction of unauthorized excavation.

4. For Raceways Less Than 30" Below Surface of Roadways: Provide 4" thick concrete base slab support. After raceway installation, provide 4" thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.

J. Backfill Placement: Place backfill and fill materials in layers of not more than 8" in loose depth for material compacted by heavy equipment, and not more than 4" in loose depth for material compacted by hand-operated tampers. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately same elevation in each lift.

K. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.

L. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D1557 and not less than the following percentages of relative density, determined in accordance with ASTM D2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).

1. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive materials and 95 percent relative density for cohesionless materials.

2. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive materials, and 95 percent relative density for cohesionless materials.

3. Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive materials, and 90 percent relative density for cohesionless materials.

M. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.

N. Subsidence: Where subsidence occurs at electrical installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

3.10 CONCRETE WORK

A. General: All concrete shall be prepared from approved materials and poured on clean, stable surfaces.

B. Exterior Base Surfaces: Six-inch layer of crushed stone over well consolidated, stable, undisturbed soil. Where the underlying soil contains excess organic material, trash or voids, or fails to provide solid bearing for any other reason, excavate to the depth required for solid bearing and re-establish the required elevation with approved granular materials.

C. Finishing: Trowel all exposed surfaces smooth. Round-off or chamfer all exposed edges.

D. Curing: Beginning immediately after placement, protect concrete from premature drying, excessive hot or cold temperatures and mechanical injury. Maintain minimal moisture loss at relatively constant temperature throughout period necessary for hydration of cement and hardening of concrete.

3.11 REFINISHING AND TOUCH UP PAINTING

A. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

B. Repair damage to paint finishes with matching touch-up coating recommended by manufacturer.

3.12 CLEANING AND PROTECTION

A. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

END OF SECTION 260501

SECTION 260510 TEMPORARY POWER AND LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Comply with Division 1 - General Requirements, as well as Division 1 High Performance Buildings Requirements, Section 018113.13.

1. HPB credits may be related to this section. HPB credits shall be reviewed for their potential applicability and conformed with as though listed for credits 16a-38k-4(b)4, 16a-38k-4(b)5.

a. The above HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed

1.2 DESCRIPTION OF WORK

A. Provide and maintain temporary electric service, power distribution and lighting systems necessary for construction of Project.

1.3 QUALITY ASSURANCE

A. Comply with all NECA, NEMA and UL standards and regulations pertaining to temporary electrical facilities, and all applicable codes and ordinances in effect at the Project site.

PART 2 - PRODUCTS

2.1 TEMPORARY ELECTRICAL SERVICE

A. Ratings: Provide temporary electrical service, size as needed.

B. General: New or used UL listed materials in good condition and of quality to assure adequate safety and operation.

2.2 POWER DISTRIBUTION

A. Provide feeders and branch circuits of adequate size and proper characteristics as required to supply temporary receptacle and lighting loads. Size service and feeder conductors to restrict voltage drop to maximum 5 percent at 80 percent power factor. Provide properly sized overcurrent protection for each electrical circuit.

B. Provide temporary electrical services as required to each construction office and storage shed used during the construction period initially and for any necessary relocations on-site.

2.3 RECEPTACLE REQUIREMENTS

A. Provide temporary receptacle outlets as required for operation of portable tools and appliances during the construction period.

B. Provide a minimum of one duplex 120 volt receptacle per 2500 square feet of building floor area, with maximum spacing of 50 feet on center.

C. All receptacle branch circuits to be rated 20 amps with a maximum of (3) duplex receptacles per circuit. Receptacle branch circuits shall be independent of temporary lighting circuits.

2.4 LIGHTING REQUIREMENTS

A. Provide both interior and exterior lighting as required to provide adequate illumination for safe and proper construction operations and Project site security.

B. Provide a minimum of one 200 watt lamp per 625 square feet of building floor area, with maximum spacing of 25 feet on center.

C. Provide one 200 watt lamp per landing at each stairway.

D. Provide adequate lighting for personnel safety at barricades, ladders, openings and other similar locations.

E. When necessary, provide supplemental lighting using suitable portable lighting units with cords and plugs.

F. All lighting branch circuits to be loaded to a maximum of 1400 watts per 20 amp circuit. Lighting branch circuits shall be independent of temporary receptacle circuits.

G. Do not use permanent lighting systems for temporary construction lighting purposes.

2.5 MAXIMUM LOADS

A. Lighting and power loads connected to the system shall be subject to the following maximum individual loads:

Load Type	Maximum KVA Size
120 volt, 1-phase	1.5
277 volt, 1-phase	3.5
208 volt, 3-phase	5.0
Electric Welders	(connection to system not permitted)

2.6 ELECTRIC WELDERS

A. Power for electric welders and for other loads larger than the maximum allowable sizes shall be taken from portable power sources provided, paid for and operated by Contractor or Subcontractor requiring the use of such equipment. Remove facilities when work is completed.

2.7 ELECTRICAL ENERGY COSTS

A. Charges for electrical energy usage for temporary power and lighting system shall be paid by the Owner, when taken from the Owner's electrical services. Contractors and Subcontractors shall exercise measures to conserve energy usage.

2.8 RECEPTACLES

A. 120 volt, 15 or 20 amp, duplex grounding type with ground fault circuit interrupter and suitable outlet box and coverplate. Power cords to be grounded and suitable for hard-service usage, with heavy duty plugs.

2.9 LAMP HOLDERS AND LIGHT FIXTURES

A. Medium base pigtail type lampholders with approved lamp guard protectors. Provide weatherproof light fixtures where exposed to moisture.

B. Do not suspend temporary lights by their electric cords unless cords and lights are specifically designed for that purpose.

2.10 CONDUCTORS

A. Insulated copper or aluminum, with conductor insulation rated for applied voltage, and insulation and jacketing suitable for the conditions of use. Branch circuit conductors to be minimum size #12 AWG, and #10 AWG for circuits longer than 100 feet unless otherwise required.

2.11 CONDUIT/RACEWAY

A. Types as required and permitted by code.

PART 3 - EXECUTION

3.1 GENERAL

A. Install the temporary power and lighting system as soon as construction progress permits.

B. Comply with applicable codes relating to permanent work for temporary electric service, and for circuits installed where accessible from streets, sidewalks or other thoroughfares of public access.

C. Route temporary wiring to minimize conflicts with other work. In general, run wiring within building overhead at or above ceiling height and supported on insulators spaced no more than 10 feet apart. Rise vertically through building where wiring will be least exposed to damage from construction operations.

D. Provide metal conduit, tubing or armored cable for protection of temporary wiring where exposed to possible damage during construction operations. Non-metallic sheathed cable may be used elsewhere. Do not use plain, exposed insulated conductors.

E. Provide suitable boxes in enclosures for all electrical equipment and wiring devices.

F. Installed raceways for the permanent installation may be used for the installation of temporary wiring. Do not use permanent wiring for construction purposes.

3.2 SPLICES/CONNECTIONS

A. Solder all conductor splices or use approved mechanical connectors. Insulate all splices by taping or other approved method.

3.3 SYSTEM OPERATION

A. Temporary power and lighting system shall be used under the direction of the electrical Subcontractor at all times.

B. Coordinate use of the system so that the electrical demand does not exceed the capacity available.

C. Maintain all equipment for satisfactory and safe operation, replace burned-out defective or stolen lamps and provide necessary routine repairs.

D. Maintain portable tools and appliances operated from the temporary power system with suitable cords and plugs in good condition, and with non-current-carrying metal parts grounded.

E. Repair of any damage to system, including replacement of blown fuses, resulting from misuse or from connecting faulty equipment shall be paid for by party responsible for damage.

3.4 COORDINATION WITH CONSTRUCTION

A. As construction progress expands, remove relocated temporary facilities to meet construction needs.

3.5 REMOVAL

A. Remove temporary power and lighting system when there is no longer any need for it, or when directed. All temporary wiring and equipment shall be removed prior to final completion.

3.6 PERMANENT POWER SYSTEM

A. When scheduled and as job conditions and progress permit, make permanent electrical service and distribution system available for use for testing and operation of required heating and ventilation equipment, etc. that are installed in permanent position. All permanent enclosures and partitions must be in place around major electrical equipment (and it shall be completely tested) prior to energizing equipment.

END OF SECTION 260510

SECTION 260519 (OPS) - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (OFF-SITE PUMP STATION NO. 2)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816, Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS

B. Product Data: For each type of product indicated.

C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Cable Corporation.
2. Senator Wire & Cable Company.

3. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Power Systems, Inc.
2. O-Z/Gedney; EGS Electrical Group LLC.
3. 3M; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Stranded for all.

B. Branch Circuits: Copper. Stranded for all.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN, THWN, single conductors in raceway.

B. Feeders Concealed Underground: Type THHN-THWN, single conductors in raceway.

C. Exposed Branch Circuits: Type THHN-THWN, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

B. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

C. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

D. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519 (OPS)

SECTION 260519 BUILDING WIRE AND CABLE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. Description of Work: Provide wire, cable, and connectors as indicated or required for all feeders, branch circuits, control circuits, etc.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed

1.3 SUBMITTALS

A. Product Data: Manufacturer's descriptive literature for each wire and connector type to be used on the project.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.5 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wire and cable to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For wire and cable manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 QUALITY ASSURANCE SUBMITTALS

A. Manufacturers certification letter in accordance with %%U NOTICE TO CONTRACTOR – POTENTIAL FOR ASBESTOS CONTAINING MATERIALS.

PART 2 - PRODUCTS

2.1 GENERAL

A. All wiring systems to consist of individual conductors installed in conduit or other raceway, unless specifically indicated otherwise.

2.2 600 VOLT CLASS WIRE

A. General: All wire and cable shall be constructed in accordance with all applicable ICEA, NEMA and IEEE published standards, and shall be UL-listed and labeled.

B. Single-conductor, 98% conductivity, annealed uncoated copper conductor, with 600-volt rated insulation.

C. #10 AWG and Smaller: Solid or stranded, 75°C with Type THWN insulation.

D. #8 AWG and Larger: Class B stranded, 75°C with Type THWN insulation.

E. Do not use aluminum, or copper-clad aluminum alloy conductors.

F. Acceptable Manufacturers: ; Rome; Southwire, PWC.

2.3 CONNECTORS

A. General: UL-listed, factory fabricated, designed for the application.

B. Splicing Connectors (#14-10 AWG): Nylon shell insulated metallic screw-on connectors.

C. Cable Connectors (#8 AWG and Larger): Cable connectors for making terminations, tee-taps and splices shall be bolted pressure or compression type lugs and connectors, with molded plastic insulators.

D. Terminations (#10 AWG and smaller, stranded): Nylon insulated, crimp ring or fork type terminals for connection to screw terminals.

E. Acceptable Manufacturers: Amp; Burndy, Ilsco; Ideal; 3M; Thomas & Betts.

2.4 TAPES

A. Acceptable manufacturers: Plymouth; 3M Scotch Brand.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine all wire and cable prior to installation. Do not use wire and cable with bruised, cut, or abraded insulation; or wire that does not pass a continuity test.

3.2 CONDUCTOR SIZES AND QUANTITIES

A. Minimum Conductor Size: All branch circuit wiring shall be minimum #12 AWG. All control circuit wiring shall be minimum #14 AWG. Provide larger sizes as indicated or required.

B. Branch Circuit Conductor Sizes: Provide branch circuit conductor sizes as indicated on the panelboard schedules, plans, or elsewhere. Neutral conductor size to match phase conductors unless approved by Engineer.

C. Equipment Grounding Conductor Required: For each branch circuit and feeder run, provide an equipment grounding conductor for continuous length of run, sized per NEC 250.122 (minimum), larger if so indicated.

D. Separate Neutral: For branch circuit homeruns with two or three single-pole circuits (of different phases) use separate neutral conductors, unless approved by Engineer.

E. Combining Homeruns: Do not combine separately indicated homeruns in single conduit unless indicated or approved by the Engineer.

F. Switch Legs: Provide branch circuit switch legs and travelers as required for the switching indicated.

G. Feeders: Provide feeder conductor sizes and quantities as indicated.

3.3 INSTALLATION

A. General: Install all conductors and other associated items in compliance with applicable requirements of NEC, NEMA, UL and NECA's "Standards of Installation" and in accordance with manufacturer's recommendations.

B. In Raceway: Install all wiring in conduit or other specified raceway, unless indicated otherwise.

C. Terminations: Furnish and install terminations, including lugs if necessary, to make all electrical connections indicated or required. Make connections and terminations for all stranded AWG conductors using crimp, clamp, or box type connectors and terminators. Enclose all strands of stranded conductors in connectors, and lugs.

D. Tightening: Tighten all connectors, lugs, screws, bolts, Allen-heads and other electrical fasteners to torque values per manufacturer's written instructions.

E. Restrictions: Do not substitute smaller conductors with higher temperature rated insulations in lieu of conductor size shown on Drawings.

3.4 COLOR CODE

A. Color code all branch circuit and feeder conductors as follows:

B. 208/120 Volts:

Phase	Color
A	Black
B	Red
C	Blue
Neutral	White

C. 480/277 Volts:

Phase	Color
A	Brown
B	Orange
C	Yellow
Neutral	Gray

D. Equipment Grounding Conductors: Green

E. Conductors No. 10 AWG and Smaller: Color impregnated.

F. Conductors No. 8 and larger may use color impregnated insulation, or conductor ends may be taped. Taping to be with solid color electrical tape, lap wound, visible without removing dead-front covers in electrical equipment, with at least three inches visible at all terminations and electrical boxes.

3.5 PHASE ARRANGEMENT

A. Arrange phases in all electrical equipment as follows:

1. A, B, C: Front to Rear.
2. A, B, C: Top to Bottom.
3. A, B, C: Left to Right When Facing Established Front of Equipment.

3.6 HIGH TEMPERATURE WIRE

A. Provide conductors with not less than 90°C rated insulation when branch circuit wiring is attached to high temperature light fixtures (e.g. fluorescent & HID), boilers, incinerators, kitchen exhaust fans, other heat-producing equipment, and "100% Rated" overcurrent protective devices. Use special higher temperature wire as required for connection to specialty equipment as required by equipment manufacturer.

END OF SECTION 260519

SECTION 260523 MOTOR POWER AND CONTROL WIRING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All Division 26 Specifications shall apply to this Section.

B. Comply with Division 1 - General Requirements, as well as Division 1 High Performance Buildings Requirements, Section 018113.13.

1. HPB credits may be related to this section. HPB credits shall be reviewed for their potential applicability and conformed with as though listed for credits 16a-38k-4(b)4, 16a-38k-4(b)5.

a. The above HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed

1.2 SUMMARY

A. Description of Work: Provide all power and control wiring for and make connections to motors and motor control equipment.

B. Motors: In general, motors are provided under Division 23.

C. Motor Control Equipment: In general, motor control equipment is provided under Division 26, and installed and wired under Division 26. Exceptions are as indicated on the drawings and specified herein.

D. Coordinate with Division 21-23 so that:

1. There is no duplication of services or materials provided.

2. Motor controllers provided are specifically designed for and fully compatible with each motor supplied by Division 21-23, in every aspect.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

2. Wiring Diagrams: For each motor provide computer generated power wiring and control ladder diagrams specifically developed for this project.

1.4 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Motor Power and Wiring shall be include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Motor Power and Wiring see manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Minimum Components and Installation Requirements: NFPA70 "National Electrical Code" (NEC).

PART 2 - PRODUCTS

2.1 GENERAL

A. Equipment and materials as specified elsewhere in Division 26 or as indicated on the Drawings.

PART 3 - EXECUTION

3.1 GENERAL

A. Connections: Make all connections to motors and control equipment complete and leave equipment in proper operating order. Connect power to motors for correct rotation. Verify nameplate ratings of all motors. Report any deviations or discrepancies.

B. Coordination: Coordinate with Division 21-23 as required.

3.2 POWER WIRING

A. General: Unless indicated otherwise, provide all required power wiring from indicated power source to each disconnect, controller, and motor, as required.

1. If wire size is not indicated, minimum size will be as indicated in NEC Article 430.

3.3 CONTROL WIRING

A. General: Automatic temperature control wiring for HVAC equipment shall be provided under Division 23. Wiring from motor controllers to remote control stations, and interlock wiring is to be provided under Division 26.

B. Coordination: Provide all control wiring as indicated on the Division 16 motor control notes, diagrams or elsewhere. Coordinate all control interfaces with Division 23.

C. Wire Size: Unless indicated otherwise use No. 14 AWG wire for all control circuits. For circuits longer than 200 feet use No. 12 AWG wire.

D. Control Circuit Power: Connect all control circuitry for motors so that when the circuit to the motor is disconnected, the control power is also disconnected. When control power is from a source other than the motor's power source, install an auxiliary control power interlock switch integral with the motor's or motor controller's disconnect. If the equipment design does not allow this, install a lockable, labeled control power disconnect immediately adjacent to the motor disconnect.

E. Installation: Install all control wiring in conduit. Neatly group, tie and strap in place all control wiring, and terminate at labeled terminal strips.

3.4 ROOF-TOP EQUIPMENT

A. Install wiring to roof-top equipment (e.g. power roof ventilators) in such a way that all conduit and wiring will be covered by unit. Seal conduit roof penetrations as indicated in the Contract Documents and Specifications.

END OF SECTION 260523

SECTION 260526 (OPS) - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS (OFF-SITE PUMP STATION NO. 2)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. This Section includes methods and materials for grounding systems and equipment**.**

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816, Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS

B. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Stranded Conductors: ASTM B 8.
2. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
3. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel 3/4 inch diameter by10 feet in length.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install stranded conductors for all ground wires, unless otherwise indicated.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

END OF SECTION 260526 (OPS)

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Comply with Division 1 - General Requirements, as well as Division 1 High Performance Buildings Requirements, Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-3(h)

1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Test wells.
2. Ground rods.
3. Ground rings.
4. Grounding arrangements and connections for separately derived systems.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Grounding and Bonding to be included in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Grounding and Bonding as specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. ERICO International Corporation.
3. Harger Lightning and Grounding.

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.

2. Stranded Conductors: ASTM B 8.

3. Tinned Conductors: ASTM B 33.

4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.

5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad; 3/4 inch by 10 feet (19 mm by 3 m).

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.

2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.

2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.

2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.

3. Connections to Ground Rods at Test Wells: Bolted connectors.

4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.

8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

9. Garage Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying garage equipment.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.6 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260533 "Raceways and Boxes for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.

1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building as indicated.

1. Install copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.

2. Bury ground ring not less than 24 inches (600 mm) from building's foundation.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal**,** at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole Grounds: 10 ohms.

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 (OPS) - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS (OFF SITE PUMP STATION NO. 2)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

A. RMC: Rigid metal conduit.

B. RNC: Rigid nonmetallic conduit.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816, Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS

B. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. ERICO International Corporation.
c. Thomas & Betts Corporation.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for RNC and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT**,** IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To New Concrete: Bolt to concrete inserts.
   2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   3. To Existing Concrete: Expansion anchor fasteners.
   4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete.

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529 (OPS)

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Comply with Division 1 - General Requirements, as well as Division 1 High Performance Buildings Requirements, Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5

1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their applicability and conformed with as though listed

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For the following:

1. Steel slotted support systems.

C. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cooper B-Line, Inc.; a division of Cooper Industries.
b. Thomas & Betts Corporation.
c. Unistrut; Tyco International, Ltd.

3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

6. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least [25] percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.

2. To New Concrete: Bolt to concrete inserts.

3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm)

thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.

6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.

7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in specifications for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 (OPS) - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS (OFF-SITE PUMP STATION NO. 2)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

A. RMC: Rigid metal conduit.

B. LFNC: Liquidtight flexible nonmetallic conduit.

C. RNC: Rigid nonmetallic conduit.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816, Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS

B. Product Data: For raceways, and fittings.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube & Conduit; a Tyco International Ltd. Co.
2. O-Z Gedney; a unit of General Signal.
3. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. Fittings for Conduit (Including all Types and Flexible and Liquidtight), and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed. Coordinate first subparagraph below with Drawings.

2.2 BOXES AND ENCLOSURES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1.
2. Hoffman.
3. Spring City Electrical Manufacturing Company.
4. Thomas & Betts Corporation.

B. Sheet and Device Boxes: NEMA 3R.

C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

D. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit.
2. Concealed Conduit, Aboveground: Rigid steel conduit.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFNC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

D. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

E. Do not install aluminum conduits.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

D. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

E. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

F. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533 (OPS)

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Comply with Division 1 - General Requirements, as well as Division 1 High Performance Buildings Requirements, Section 018113.13.

1. HPB credits may be related to this section. HPB credits shall be reviewed for their potential applicability and conformed with as though listed for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-3(h).

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

2. Section 280528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

D. Samples: For wireways, nonmetallic wireways, and surface raceways, and for each color and texture specified, 12 inches (300 mm) long.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.

2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

D. Source quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Raceways and Boxes to be include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Raceways and Boxes specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit.
3. O-Z/Gedney.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. FMC: Comply with UL 1; zinc-coated steel.

I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.

2. Fittings for EMT:

a. Material: Steel.
b. Type: compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

K. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. RACO; Hubbell.
3. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. Rigid HDPE: Comply with UL 651A.

G. Continuous HDPE: Comply with UL 651B.

H. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.

I. RTRC: Comply with UL 1684A and NEMA TC 14.

J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

K. Fittings for LFNC: Comply with UL 514B.

L. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

M. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, **Type 1**, unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Moulded Products, Inc.
2. Hoffman.
3. Lamson & Sessions; Carlon Electrical Products.

B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

F. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Mono-Systems, Inc.
b. Panduit Corp.
c. Wiremold / Legrand.

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell Incorporated.
b. Panduit Corp.
c. Wiremold / Legrand.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hoffman.
2. O-Z/Gedney.
3. Thomas & Betts Corporation.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:

1. Material: sheet metal.

2. Type: Fully adjustable.

3. Shape: Rectangular.

4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable, rectangular.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

J. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

L. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

M. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

N. Gangable boxes are prohibited.

O. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 in office ares, Type 12 in garage areas with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic or Fiberglass.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

P. Cabinets:

1. NEMA 250, Type 1> galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel, unless otherwise indicated. Panel fronts are to have a door (circuit breakers) in door (circuit breakers & wiring gutters) in trim with concealed hinges and flush type tumbler lock. All panels shall be keyed alike. Doors in excess of 48" high shall be equipped with a three-point catch and vault handle with integral tumbler lock. Panel shall be dead front, safety type and be multi-section as noted or as necessary to comply with NEC.

2. Key latch to match panelboards.

3. Metal barriers to separate wiring of different systems and voltage.

4. Accessory feet where required for freestanding equipment.

5. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements.

2. Basis of Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Armorcast Products Company.
b. Quazite: Hubbell Power System, Inc.

3. Standard: Comply with SCTE 77.

4. Configuration: Designed for flush burial with [open] [closed] [integral closed] bottom unless otherwise indicated.

5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

7. Cover Legend: Molded lettering, "ELECTRIC," or as noted

8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

9. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of reinforced concrete.

1. Manufacturers: Subject to compliance with requirements.

2. Basis-of-Design Product: Subject to compliance with requirements, provide[product indicated on Drawings or comparable product by one of the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. Quazite: Hubbell Power System, Inc; Hubbell Power Systems.

3. Standard: Comply with SCTE 77.

4. Color of Frame and Cover: Gray.

5. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.

6. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

7. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

8. Cover Legend: Molded lettering, "ELECTRIC," or as noted.

9. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

10. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.

2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.

2. Concealed Conduit, Aboveground: GRC; EMT.

3. Underground Conduit: RNC, Type EPC-40-PVC; Type EPC-80-PVC; concrete encased.

4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC; LFNC.

5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.

2. Exposed, Not Subject to Severe Physical Damage: EMT

3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:

a. Loading dock.
b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
c. Mechanical rooms.
d. Garages.
e. Storage Rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

6. Damp or Wet Locations: GRC.

7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 indamp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm)] trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use setscrew steel fittings. Comply with NEMA FB 2.10.

4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C) .

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches (300 mm)of enclosures to which attached.

I. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m)intervals.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

3. Arrange raceways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.

4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

5. Change from ENT to GRC before rising above floor.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm)radius control at bend points.

2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where an underground service raceway enters a building or structure.

3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

W. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.

b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.

c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed luminaires equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

BB. Locate boxes so that cover or plate will not span different building finishes.

CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

EE. Set metal floor boxes level and flush with finished floor surface.

FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.

2. Install backfill as specified in Section 312000 "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.

b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.

7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes with bottom below frost line, 30” below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260553 (OPS) - IDENTIFICATION FOR ELECTRICAL SYSTEMS (OFF-SITE PUMPS STATION NO. 2)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Identification for conductors and communication cable.
   2. Equipment identification labels.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816, Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS

B. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and ANSI C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND COMMUNICATION CABLE IDENTIFICATION MATERIALS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a black background. Minimum letter height shall be 3/8 inch (10 mm).

PART 3 - EXECUTION

3.1 APPLICATION

A. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. Identify each ungrounded conductor according to source and circuit number.

B. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

   a. Equipment: Engraved, laminated acrylic or melamine label.

2. Equipment to Be Labeled:
   a. Disconnect switches.
   b. Generator
   c. Transfer Switch

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

E. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Colors for 208/120-V Circuits:

   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
   d. Neutral: White
   e. Ground: Green

2. Colors for 480/277-V Circuits:

   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow. Neutral: White
   d. Ground: Green

3. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

END OF SECTION 260553 (OPS)

SECTION 260553 ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Description of Work: Provide nameplates, labeling and other identification means for electrical systems equipment, devices, raceways and wires, as indicated.

C. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed

1.3 SUBMITTALS

A. Product Data: Manufacturer's descriptive literature and/or samples for each type of nameplate, label, marker, etc. to be used on the project.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.5 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Amp, Ideal, Panduit.

2.2 NAMEPLATES

A. Three-layer laminated plastic with minimum 3/16" high white engraved characters on black background, and punched for mechanical fastening. Fasteners: self-tapping stainless-steel screws or number 10-32 stainless steel machine screws with nuts and flat and lock washers.

2.3 UNDERGROUND WARNING TAPE

A. Six-inch wide polyethylene tape, permanently bright colored with continuous-printed legend indicating general type of underground line below and “CAUTION.” Colors are as follows:

1. Red - Electric.
2. Orange - Communications.

2.4 MARKING PENS

A. Permanent, waterproof, quick drying black ink. Acceptable Manufacturers: Sanford Fine Point “Sharpie,” or equal.

2.5 WIRE TAGS

A. Vinyl or vinyl-cloth self-adhesive wraparound type indicating appropriate circuit number, etc.

PART 3 - EXECUTION

3.1 GENERAL

A. Clean all surfaces to receive nameplates, label or marking, and prepare according to manufacturer’s written instructions.

B. Install nameplates centered and parallel to equipment lines, and secure with screws as indicated. Do not use rivets or adhesives.

C. Locate nameplate, marking, or other identification means on outside of equipment or box front covers when above ceilings and when in mechanical or electrical equipment rooms or other unfinished areas, and on inside of front cover when in finished rooms/areas.

D. Legends: Use Contract Document designations for identification unless indicated otherwise.

E. Provide the following identification, in addition to identification required by the NEC, and equipment nameplates required by NEMA and UL.

3.2 NAMEPLATES

A. Provide an engraved nameplate (with minimum height characters indicated) for each:

1. Power center, switchboard, distribution panel, and motor control center (1/2" H.).

2. Overcurrent device, motor starter, and any other device mounted in any of the above (5/16"H).

3. Branch circuit panelboard, safety switch, individually mounted motor starter, individually mounted circuit breaker, transformer, relay and contactor enclosure, and miscellaneous electrical cabinet (5/16" H.).

4. Motor control station, and toggle switch located remote from load served or where function is not easily evident (3/16" H).

5. Communications and special system cabinet (5/16" H.).

B. Embossed “Dymo” tapes will not be an acceptable substitute.

3.3 UNDERGROUND WARNING TAPES

A. During trench backfilling for each underground electrical, telephone, signal and communications line, provide a continuous underground warning tape located directly above line, at six to eight inches below finished grade.

3.4 MARKING PEN LABELING

A. Mark each of the following, as indicated:

1. Distribution panel and branch circuit panelboard tubs (indicate panel designation on inside of tub so that panel may be identified when its cover is removed).

2. Branch circuit panelboard pole spaces (indicate respective circuit numbers). Note - Panelboard manufacturer supplied pole space identification means may be used in lieu of marking pen, except that pre-printed stickers will not be accepted.

3. Branch circuit and feeder pull and junction box covers (indicate appropriate panel and circuit number(s) of conductors enclosed).

4. Safety switch, individual circuit breaker and motor starter covers (indicate appropriate panel and circuit number serving the equipment).

5. Wiring device coverplates (indicate appropriate panel and circuit number(s) serving the device(s)).

6. Covers for communications and other special electrical systems pull, junction and outlet boxes. Indicate appropriate system and zone or circuit numbers, etc. as applicable. Use easily recognized system abbreviations (e.g., “FA” for fire alarm; “I/C” for intercom; “TEL” for telephone; “TV” for television antenna; “PA” for public address; “SEC” for security; “V/D” for voice/data, etc).

3.5 WIRE TAGS

A. Power Circuits: Apply wire tag indicating appropriate circuit or feeder number to each conductor present in distribution panel and panelboard gutters, and to each conductor in pull and junction boxes where more than one feeder or multi-wire branch circuit is present. Where only a single feeder or multi-wire branch circuit is present, box cover labeling and conductor color coding is sufficient.

B. Control, Communications and Signal Circuits: Apply wire tag indicating circuit or termination number at all terminations and at all intermediate locations and boxes where more than one circuit is present.

3.6 BRANCH CIRCUIT PANELBOARD DIRECTORIES

A. For each panelboard, accurately complete the circuit directory card in typewritten form, identifying load served or “spare” or “space” for each circuit pole space. Use actual Owner designated room numbers or names (not construction room designations).

3.7 FUSES AND OVERLOADS

A. At each location where fuses are installed (safety switches, motor starters, control transformers, etc.) provide an adhesive label indicating fuse manufacturer, type, voltage and ampere rating, and affix to inside of enclosure front cover.

B. For each motor starter, provide adhesive label indicating overload element manufacturer, type, size and catalog number, and affix to inside of enclosure front cover.

3.8 MANHOLE DUCT ENTRIES

A. Provide an engraved nameplate for each duct entry in each manhole. Lettering to be minimum 3/4" high. Indicate feeder designation for power lines, system designation for telecommunications lines, and designation of manhole at opposite end of ductline. Exact wording to be as approved by the Owner.

END OF SECTION 260553

SECTION 260573.13 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

C. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-(b)5

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed

1.3 DEFINITIONS

A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

C. SCCR: Short-circuit current rating.

D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For computer software program to be used for studies.

C. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.

1. Short-circuit study input data, including completed computer program input data sheets.

2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Short-Circuit Study Specialist.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.6 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer and shall be stamped and signed by the professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Software Developers: Subject to compliance with requirements, available software developers offering software that may be used for the Work include, but are not limited to, the following:

1. ESA Inc.
2. Easy Power LLC;
3. SKM Systems Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.

2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.

3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.

5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.

G. Short-Circuit Study Output:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.

b. Calculated symmetrical fault-current magnitude and angle.

c. Fault-point X/R ratio.

d. Calculated asymmetrical fault currents:

1) Based on fault-point X/R ratio.
2) Based on calculated symmetrical value multiplied by 1.6.
3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.

b. Calculated symmetrical fault-current magnitude and angle.

c. Fault-point X/R ratio.

d. No AC Decrement (NACD) ratio.

e. Equivalent impedance.

f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.

g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Obtain all data necessary for the conduct of the study.

1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.

2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Obtain electrical power utility impedance at the service.

3. Power sources and ties.

4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.

5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.

6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.

7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.

8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.

9. Motor horsepower and NEMA MG 1 code letter designation.

10. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:

1. Electric utility's supply termination point.
2. Incoming switchgear.
3. Unit substation primary and secondary terminals.
4. Low-voltage switchgear.
5. Motor-control centers.

6. Control panels.
7. Standby generators and automatic transfer switches.
8. Branch circuit panelboards.
9. Disconnect switches.

3.3 ADJUSTING

A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.4 DEMONSTRATION

A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION 260573.13

SECTION 260573.16 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

1. Study results shall be used to determine coordination of series-rated devices.

C. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5

a. The above listed credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed as though listed

1.3 DEFINITIONS

A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

C. SCCR: Short-circuit current rating.

D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For computer software program to be used for studies.

C. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.

2. Study and equipment evaluation reports.

3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Coordination Study Specialist.

B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Overcurrent Protective Device Coordination Study to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Operation and Maintenance Data: For the overcurrent protective devices to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. The following parts from the Protective Device Coordination Study Report:

1) One-line diagram.
2) Protective device coordination study.
3) Time-current coordination curves.

b. Power system data.

1.7 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Coordination Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Coordination Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer. Study shall be signed and stamped by this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers: Subject to compliance with requirements, available software developers offering software that may be used for the Work include, but are not limited to, the following:

1. ESA Inc.
2. Easy Power, LLC.
3. SKM Systems Analysis, Inc.

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.
b. Simultaneous faults.
c. Explicit negative sequence.
d. Mutual coupling in zero sequence.

2.2 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

   a. Voltage.
   b. Calculated fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

   a. Voltage.

   b. Calculated symmetrical fault-current magnitude and angle.

   c. Fault-point X/R ratio.

   d. Calculated asymmetrical fault currents:

      1) Based on fault-point X/R ratio.
      2) Based on calculated symmetrical value multiplied by 1.6.
      3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

   a. Voltage.

   b. Calculated symmetrical fault-current magnitude and angle.

   c. Fault-point X/R ratio.

   d. No AC Decrement (NACD) ratio.

   e. Equivalent impedance.

   f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.

   g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

F. Protective Device Coordination Study:

1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.

   a. Phase and Ground Relays:

      1) Device tag.
      2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
      3) Recommendations on improved relaying systems, if applicable.

b. Circuit Breakers:

1) Adjustable pickups and time delays (long time, short time, ground).
2) Adjustable time-current characteristic.
3) Adjustable instantaneous pickup.
4) Recommendations on improved trip systems, if applicable.

c. Fuses: Show current rating, voltage, and class.

G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.

2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

4. Plot the following listed characteristic curves, as applicable:

a. Power utility's overcurrent protective device.

b. Medium-voltage equipment overcurrent relays.

c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.

d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.

e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.

f. Cables and conductors damage curves.

g. Ground-fault protective devices.

h. Motor-starting characteristics and motor damage points.

i. Generator short-circuit decrement curve and generator damage point.

j. The largest feeder circuit breaker in each motor-control center and panelboard.

5. Series rating on equipment allows the application of two series interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Both devices share in the interruption of the fault and selectivity is sacrificed at high fault levels. Maintain selectivity for tripping currents caused by overloads.

6. Provide adequate time margins between device characteristics such that selective operation is achieved.

7. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 PROTECTIVE DEVICE COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. The study shall be based on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

a. Inrush current when first energized.

b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.

c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:

1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.

2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.

K. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:

1. Electric utility's supply termination point.
2. Switchgear.
3. Unit substation primary and secondary terminals.
4. Low-voltage switchgear.
5. Motor-control centers.
6. Standby generators and automatic transfer switches.
7. Branch circuit panelboards.

M. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.

2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.

3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.

3.3 LOAD-FLOW AND VOLTAGE-DROP STUDY

A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:

1. Determine load-flow and voltage drop based on full-load currents obtained in "Power System Data" Article.

2. Determine load-flow and voltage drop based on 80 percent of the design capacity of the load buses.

3. Prepare the load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.4 MOTOR-STARTING STUDY

A. Perform a motor-starting study to analyze the transient effect of the system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze the effects of the motor starting on the power system stability.

B. Prepare the motor-starting study report, noting light flicker for limits proposed by IEEE 141, and and voltage sags so as not to affect the operation of other utilization equipment on the system supplying the motor.

3.5 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.

1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Architect.

2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

3. For existing equipment, whether or not relocated obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.

B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 241 and IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Electrical power utility impedance at the service.

3. Power sources and ties.

4. Short-circuit current at each system bus, three phase and line-to-ground.

5. Full-load current of all loads.

6. Voltage level at each bus.

7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.

8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.

9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.

10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.

11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.

12. Maximum demands from service meters.

13. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.

14. Motor horsepower and NEMA MG 1 code letter designation.

15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).

16. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

17. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.

    b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.

    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.

    d. Generator thermal-damage curve.

    e. Ratings, types, and settings of utility company's overcurrent protective devices.

    f. Special overcurrent protective device settings or types stipulated by utility company.

    g. Time-current-characteristic curves of devices indicated to be coordinated.

    h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.

    i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.

    j. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.

    k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.6 FIELD ADJUSTING

A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.7 DEMONSTRATION

A. Engage the Coordination Study Specialist to train Owner's maintenance personnel in the following:

1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.

2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.

3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 260573.16

SECTION 260573.19 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

C. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For computer software program to be used for studies.

C. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.

1. Arc-flash study input data, including completed computer program input data sheets.

2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Arc-Flash Study Specialist.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

B. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer. Professional engineer shall sign and stamp all documentation.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers: Subject to compliance with requirements, available software developers offering software that may be used for the Work include, but are not limited to, the following:

1. ESA Inc.
2. Easy Power, LLC
3. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.

b. Calculated symmetrical fault-current magnitude and angle.

c. Fault-point X/R ratio.

d. No AC Decrement (NACD) ratio.

e. Equivalent impedance.

f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.

g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

F. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Working distance.
6. Incident energy.
7. Hazard risk category.
8. Recommendations for arc-flash energy reduction.

G. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch (76-by-127-mm) thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Flash protection boundary.
4. Hazard risk category.
5. Incident energy.
6. Working distance.
7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:

1. Electric utility's supply termination point.
2. Switchgear.
3. Unit substation primary and secondary terminals.
4. Low-voltage switchgear.
5. Motor-control centers.
6. Standby generators and automatic transfer switches.
7. Branch circuit panelboards.

3.3 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Use the short-circuit study output and the field-verified settings of the overcurrent devices.

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.

2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except 240-V ac and 208-V ac systems fed from transformers less than 125 kVA.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.

2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.4 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on the one-line diagram on Drawings. Call discrepancies to the attention of Architect.

2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers.

B. Gather and tabulate the following input data to support coordination study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Obtain electrical power utility impedance at the service.

3. Power sources and ties.

4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.

5. For reactors, provide manufacturer and model designation, voltage rating and impedance.

6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.

7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.

8. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.

9. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.

10. Motor horsepower and NEMA MG 1 code letter designation.

11. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

12. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.5 LABELING

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:

1. Motor-control center.
2. Low-voltage switchboard.
3. Switchgear.
4. Medium-voltage switch.
5. Control panel.

3.6 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.7 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 260573.19

SECTION 260583 EQUIPMENT CONNECTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Description of Work: Connect complete, all equipment requiring electrical connections, furnished as part of this Contract or by others, unless indicated otherwise.

C. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13.

2. HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

PART 2 - PRODUCTS

2.1 GENERAL

A. Equipment and materials as specified elsewhere in Division 26 or as indicated on the Drawings.

PART 3 - EXECUTION

3.1 GENERAL

A. Equipment Variations: Note that equipment sizes and capacities as shown on the Contract Documents are for bidding purposes and as such may not be the exact unit actually furnished. Contractor shall anticipate minor variations in equipment and shall include in his Bid all costs required to properly connect the equipment actually furnished.

B. Verification: Obtain and review shop drawings, product data and manufacturer's instructions for equipment furnished by others. Examine actual equipment to verify proper connection locations and requirements.

C. Coordination: Sequence electrical rough-in and final connections to coordinate with installation and start-up schedule and work by other trades.

3.2 ROUGH-IN

A. Provide all required conduit, boxes, fittings, wire, connectors and miscellaneous accessories, etc. as necessary to rough in and make final connections to all equipment requiring electrical connections.

B. In general, motors and equipment shall be wired in conduit to a junction box (or safety switch) near the unit, and from there to the unit in flexible metal or liquid-tight flexible metal conduit.

3.3 CONNECTIONS

A. Provide properly sized overload and short circuit protection for all equipment connected, whether furnished under this Contract or by others.

B. Verify proper connections with manufacturer's published diagrams and comply with same.

C. Verify that equipment is ready for electrical connections, wiring and energization, prior to performing same.

D. Provide all control wiring to remote devices or equipment as indicated or required. Modify equipment control wiring, install or disconnect jumpers, etc. as required.

END OF SECTION 260583

SECTION 260800 – COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Notice to Contractor Sections, apply to this Section. Refer to NOTICE TO CONTRACTOR – COMMISSIONING for a full description of the commissioning process and requirements.

1.2. SUMMARY

A. Commissioning consists of systematically documenting that specified components and systems have been installed and started up properly and then functionally tested to verify and document proper operation through all sequences of operation and conditions. In addition, training of the Owner's Operations Personnel will be verified and final project O&M Documents will be reviewed for completeness.

PART 2 – PRODUCTS

2.1. FUNCTIONAL PERFORMANCE TESTING EQUIPMENT AND INSTRUMENTS

A. Contractor shall provide all tools, instruments, laptop computers, PDA's, software programs and services required to perform system Functional Performance Testing procedures. This includes providing the connection to systems to be tested, operation of the test equipment & instrumentation and generating test results as required.

PART 3 – EXECUTION

3.1. FUNCTIONAL PERFORMANCE TESTING

A. The contractor shall demonstrate to the Engineer and the Cx Authority the performance of the following Electrical Systems to the performance level identified.

1. Lighting Control System:

a. System/Equipment to be Tested:

1) Time switches
2) Photoelectric switches
3) Indoor occupancy sensors
4) All associated control devices

b. Functions to be Tested:
    1) Normal lighting conditions
    2) Emergency lighting conditions
    3) Operation of preset lighting schemes (time switches)
    4) Sensor and photoelectric reactions and coverage
    5) Alarm & reporting functions

c. Conditions of the Test:
    1) System shall be complete and fully operational
    2) Operation will be tested under normal and emergency power conditions

d. Acceptance Criteria:
    1) Lighting levels shall be in accordance with the specifications and IESNA recommendations
    2) Time switches shall operate in accordance with the programmed schedule
    3) Specified time delays for photoelectric switches and occupancy sensors are operating properly
    4) Occupancy sensor sensitivities meet the specification requirements

2. Emergency Power Systems:

a. System/Equipment to be Tested:
    1) Automatic Transfer Switches
    2) Emergency Generator
    3) Safety Switches

b. Functions to be Tested:
    1) Automatic Switchover to emergency generator power for all connected loads
    2) Automatic re-transfer to normal power when normal source is restored

c. Conditions of the Test:
    1) Simulate a failure of the normal power feeder
    2) Simulate restoration of the normal power feeder

d. Acceptance Criteria:
    1) System shall transfer to emergency power on a normal power failure within specified time period
    2) System shall re-transfer back to normal power within specified time period after restoration of normal power

3. Building Automation System:

a. System/Equipment to be Tested:
    1) Operator workstations
    2) Peripheral devices
    3) Communications cabling

b. Functions to be Tested:
    1) All features of the front end software, including but not limited to, graphical displays, setpoint & related parameter control, alarm reporting, time of day scheduling, data trending, etc.

c. Conditions of the Test:
    1) System shall be complete and fully operational
    2) Operation will be tested under normal and emergency power conditions

d. Acceptance Criteria:
    1) Graphics shall be clear and uncluttered
    2) All system software and applications shall be the current revision available

END OF SECTION 260800

SECTION 260800 COORDINATED SHOP DRAWINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5

2. The above HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed

1.3 DESCRIPTION OF WORK

A. This section describes the coordination and procedural requirements for Division 26 Contractors in conjunction with these divisions on multi-prime contracts or as otherwise specified.

B. Definitions:

1. Owners Representative - Architect, Engineer Construction Manager, General Contractor, Clerk of the works or any stipulated Agent or Representative of the Owner.

2. GC - General Contractor

3. MC - Mechanical Contractor/Subcontractor

4. PC - Plumbing Contractor/Subcontractor

5. EC - Electrical Contractor/Subcontractor

6. SM - Sheet Metal Subcontractor

7. SC - Sprinkler Contractor/Subcontractor

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 DESCRIPTION

A. The coordination of work for Division 23 and 26 Contractors/Subcontractors shall occur in the following manner:

1. The MC shall require the Sheet Metal Subcontractor to submit 3/8" reproducible (mylar or Sepia) shop drawings, as expeditiously as possible, to the Engineer (through normal channels) for review and approval. The shop drawings shall incorporate all duct work (including bottom of duct elevations and etc.), equipment and accessories as shown and/or specified in the contract documents.

2. All roof penetrations, wall and floor openings shall be coordinated with the structural steel Subcontractor, Supplier and/or Erector, through the Owner's Representative. All conflicts with structural steel members shall be resolved through the Owner's Representative.

3. After review and final approval of each shop drawing by the Engineer, the sheet metal Subcontractor shall incorporate all required corrections, additions and modifications on the mylar or sepia shop drawings.

4. The approved 3/8" scale mylar or sepia duct work shop drawings shall be utilized for coordination with all other Contractors or Subcontractors whose involvement is mandated. The Sheet Metal Subcontractor shall submit the 3/8" scale duct work shop drawings (mylars) to the MC to initiate the "coordination" process. The MC shall review the drawings for accuracy and completeness prior to forwarding same to the Owner's Representative for distribution.

5. The Owner's Representative shall forward the ductwork shop drawings to the PC for coordination of the plumbing work.

6. The PC shall (upon receipt of drawings from the Owner's Representative) superimpose his scope of work on the 3/8" ductwork shop drawings illustrating all plumbing equipment, piping and hangers.

7. The PC shall include invert of pipes; elevations and pipe sizes including insulation.

8. Any conflicts between the plumbing and ductwork shall be keyed by the PC with a red circle on a separate blue and white print made from the ductwork shop drawing mylar or sepia.

9. Coordination meetings will be requested to resolve the conflicts as keyed on the blue and white drawings by the PC. All conflicts that arise between the plumbing and ductwork shall be resolved through and by the Owner's Representative.

10. The PC and/or the Sheet Metal Subcontractor shall correct and shall complete the mylar drawings depicting all resolutions.

11. The PC shall "sign off" on each drawing when it is ascertained that no conflicts exist between the ductwork and plumbing work and forward the "signed off" drawings to the Owner's Representative.

12. The Owner's Representative shall forward the final ductwork/plumbing coordinated drawings to the MC.

13. The MC shall (upon receipt of drawings from the Owner's Representative) superimpose all heating and air conditioning piping, equipment, hangers, and insulation, including elevations and pipe sizes, on the 3/8" scale drawings.

14. Any conflicts between the MC, PC and SM shall be keyed by a red circle on a separate blue and white print made from the mylar or sepia by the MC.

15. Coordination meetings will be requested to resolve the conflicts as keyed on the blue and white drawings by the MC. All conflicts that arise between the MC, SM and PC shall be

resolved through and by the Owner's Representative. The MC, PC and SM shall correct and complete the mylar drawings depicting all resolutions.

16. The MC shall "sign off" on each drawing when it is ascertained that no conflicts exist between the MC, SM and PC and forward the signed off drawings to the Owner's Representative.

17. The Owner's Representative shall forward the final ductwork/plumbing/mechanical coordinated drawings to the EC.

18. The EC shall (upon receipt of drawings from the Owner's Representative) superimpose all electrical equipment including but not limited to light fixtures, conduit and hangers.

19. The EC shall include elevations of light fixtures, plumbing conduit and conduit sizes. Any conflicts with the ductwork, and/or plumbing, and/or mechanical work be keyed by the EC with a red circle on a separate blue and white print made from the mylar or sepia.

20. Coordination meetings shall be requested by the EC to resolve any conflicts as keyed on the B & W drawings. All conflicts that arise between the EC, MC, PC and SM shall be resolved through and by the Owner's Representative. The EC and/or the SM, PC, MC shall correct and complete the mylar drawings depicting all resolutions.

21. The EC shall "sign off" on each drawing when it is ascertained that no conflicts exist between the EC, MC, PC and SM and forward the signed off drawings to the Owner's Representative.

22. The Owner's Representative shall forward the final ductwork/plumbing/ mechanical/electrical coordinated drawings to the MC for forwarding to the Sprinkler Contractor (SC), if the SC is under sub-contract to the MC. If not, the drawings shall be forwarded to the Owner's Representative for distribution to the SC.

23. The SC shall (upon receipt of drawings from the MC or Owner's Representative) superimpose all sprinkler equipment, piping, hangers and sprinkler heads as required by the contract documents and the appropriate codes.

24. The SC shall include elevations of piping and piping sizes. Any conflicts with the ductwork, plumbing, mechanical or electrical work shall be keyed by the SC with a red circle on a separate blue and white print made from the mylar or sepia.

25. Coordination meetings will be requested by the SC to resolve any conflicts as keyed on the B & W drawings. All conflicts that arise between the SC and the other contractors and/or sub-contractors shall be resolved. The SC and/or the responsible contractors or sub-contractors shall complete the mylar drawings depicting all resolutions and when it is ascertained that no conflicts exist with the other Contractors or Subcontractors, the SC shall 'sign off' on each drawing.

26. The SC shall forward the signed off drawings to the Owner's Representative who shall furnish B & W prints for final distribution to all Contractors and Subcontractors.

3.2 COORDINATION MEETINGS

A. During the coordination process, separate meetings apart from project meetings concerning the progress and schedules may be called by the Owner's Representative when required or at the request of one or more of the coordinating Contractors.

1. The Owner's Representative shall contact the Contractors and make all required arrangements, e.g. time, place, etc.

2. All Contractors shall place emphasis and importance on equipment purchases, so as to not delay approvals, shop drawings and the coordinated drawings.

B. Turn-around time for coordinated drawings is extremely critical and must be performed on an expedited basis.

1. The Owner's Representative shall prepare a schedule for time allotments for each Contractor for preparation of coordinated drawings and review so that rapid progress and adherence to the schedule may be achieved.

2. The MC, upon award of contract, shall immediately engage a Sheet Metal Subcontractor who shall then be directed to initiate the ductwork shop drawing and coordination process.

3.3 SCHEDULE OF SUBMISSIONS

A. The MC and SM shall commence the ductwork shop drawings within two (2) weeks after award of contract (or authorization to proceed).

B. The Sheet Metal Subcontractor and MC shall submit the coordinated ductwork shop drawings to the Owner's Representative for review and distribution within the time-frame and schedule as directed by the Owner's Representative.

C. After review of coordinated ductwork shop drawings by the Owner's Representative, corrections shall be made, if required, prior to transmitting to the Contractor and Subcontractors for their phase of the coordinated drawings process.

D. Turn-around time for each Contractor shall be two (2) weeks maximum.

E. Upon completion of the coordination process by all Contractors and Subcontractors as described above, they shall sign off on drawings indicating company, name, date of sign-off and signature of company representative.

Signatures shall be understood to verify that each Contractor has shown their respective work on the drawings and have resolved all points of conflict and interference with other Contractors and Subcontractors.

F. Completed signed off prints of coordinated drawings shall be transmitted to all Contractors as outlined above for construction and installation. Revised and recoordinated drawings may be required to attain approval for construction drawings. The Owner's Representative shall maintain completed coordinated mylar drawings or sepias in his files.

3.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

3.5 CLOSEOUT SUBMITTALS

A. RECORD AND “AS BUILT” DRAWINGS

1. Each Contractor, after completing his segment of the coordinated drawings, shall print copies of the completed drawings and maintain same for his records.

2. At the completion of the project and at the option of the Owner’s Representative, “As Built” corrections will be made to each mylar or sepia by each of the aforementioned Contractors and returned to the Owner’s Representative for the Owner’s permanent files and records.

3. These “As Builts” do not remove the obligation of “As Builts” and record drawings as outlined under other sections of the specifications unless the Owner’s Representative elects to do so.

END OF SECTION 260800

SECTION 260810 COORDINATED SHOP DRAWINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5

2. The above HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed

1.3 DESCRIPTION OF WORK

A. This section describes the coordination and procedural requirements for Division 26 Contractors in conjunction with these divisions on multi-prime contracts or as otherwise specified.

B. Definitions:

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2. GC - General Contractor

3. MC - Mechanical Contractor/Subcontractor

4. PC - Plumbing Contractor/Subcontractor

5. EC - Electrical Contractor/Subcontractor

6. SM - Sheet Metal Subcontractor

7. SC - Sprinkler Contractor/Subcontractor

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 DESCRIPTION

A. The coordination of work for Division 23 and 26 Contractors/Subcontractors shall occur in the following manner:

1. The MC shall require the Sheet Metal Subcontractor to submit 3/8" reproducible (mylar or Sepia) shop drawings, as expeditiously as possible, to the Engineer (through normal channels) for review and approval. The shop drawings shall incorporate all duct work (including bottom of duct elevations and etc.), equipment and accessories as shown and/or specified in the contract documents.

2. All roof penetrations, wall and floor openings shall be coordinated with the structural steel Subcontractor, Supplier and/or Erector, through the Owner's Representative. All conflicts with structural steel members shall be resolved through the Owner's Representative.

3. After review and final approval of each shop drawing by the Engineer, the sheet metal Subcontractor shall incorporate all required corrections, additions and modifications on the mylar or sepia shop drawings.

4. The approved 3/8" scale mylar or sepia duct work shop drawings shall be utilized for coordination with all other Contractors or Subcontractors whose involvement is mandated. The Sheet Metal Subcontractor shall submit the 3/8" scale duct work shop drawings (mylars) to the MC to initiate the "coordination" process. The MC shall review the drawings for accuracy and completeness prior to forwarding same to the Owner's Representative for distribution.

5. The Owner's Representative shall forward the ductwork shop drawings to the PC for coordination of the plumbing work.

6. The PC shall (upon receipt of drawings from the Owner's Representative) superimpose his scope of work on the 3/8" ductwork shop drawings illustrating all plumbing equipment, piping and hangers.

7. The PC shall include invert of pipes; elevations and pipe sizes including insulation.

8. Any conflicts between the plumbing and ductwork shall be keyed by the PC with a red circle on a separate blue and white print made from the ductwork shop drawing mylar or sepia.

9. Coordination meetings will be requested to resolve the conflicts as keyed on the blue and white drawings by the PC. All conflicts that arise between the plumbing and ductwork shall be resolved through and by the Owner's Representative.

10. The PC and/or the Sheet Metal Subcontractor shall correct and shall complete the mylar drawings depicting all resolutions.

11. The PC shall "sign off" on each drawing when it is ascertained that no conflicts exist between the ductwork and plumbing work and forward the "signed off" drawings to the Owner's Representative.

12. The Owner's Representative shall forward the final ductwork/plumbing coordinated drawings to the MC.

13. The MC shall (upon receipt of drawings from the Owner's Representative) superimpose all heating and air conditioning piping, equipment, hangers, and insulation, including elevations and pipe sizes, on the 3/8" scale drawings.

14. Any conflicts between the MC, PC and SM shall be keyed by a red circle on a separate blue and white print made from the mylar or sepia by the MC.

15. Coordination meetings will be requested to resolve the conflicts as keyed on the blue and white drawings by the MC. All conflicts that arise between the MC, SM and PC shall be

resolved through and by the Owner's Representative. The MC, PC and SM shall correct and complete the mylar drawings depicting all resolutions.

16. The MC shall "sign off" on each drawing when it is ascertained that no conflicts exist between the MC, SM and PC and forward the signed off drawings to the Owner's Representative.

17. The Owner's Representative shall forward the final ductwork/plumbing/mechanical coordinated drawings to the EC.

18. The EC shall (upon receipt of drawings from the Owner's Representative) superimpose all electrical equipment including but not limited to light fixtures, conduit and hangers.

19. The EC shall include elevations of light fixtures, plumbing conduit and conduit sizes. Any conflicts with the ductwork, and/or plumbing, and/or mechanical work be keyed by the EC with a red circle on a separate blue and white print made from the mylar or sepia.

20. Coordination meetings shall be requested by the EC to resolve any conflicts as keyed on the B & W drawings. All conflicts that arise between the EC, MC, PC and SM shall be resolved through and by the Owner's Representative. The EC and/or the SM, PC, MC shall correct and complete the mylar drawings depicting all resolutions.

21. The EC shall "sign off" on each drawing when it is ascertained that no conflicts exist between the EC, MC, PC and SM and forward the signed off drawings to the Owner's Representative.

22. The Owner's Representative shall forward the final ductwork/plumbing/ mechanical/electrical coordinated drawings to the MC for forwarding to the Sprinkler Contractor (SC), if the SC is under sub-contract to the MC. If not, the drawings shall be forwarded to the Owner's Representative for distribution to the SC.

23. The SC shall (upon receipt of drawings from the MC or Owner's Representative) superimpose all sprinkler equipment, piping, hangers and sprinkler heads as required by the contract documents and the appropriate codes.

24. The SC shall include elevations of piping and piping sizes. Any conflicts with the ductwork, plumbing, mechanical or electrical work shall be keyed by the SC with a red circle on a separate blue and white print made from the mylar or sepia.

25. Coordination meetings will be requested by the SC to resolve any conflicts as keyed on the B & W drawings. All conflicts that arise between the SC and the other contractors and/or sub-contractors shall be resolved. The SC and/or the responsible contractors or sub-contractors shall complete the mylar drawings depicting all resolutions and when it is ascertained that no conflicts exist with the other Contractors or Subcontractors, the SC shall 'sign off' on each drawing.

26. The SC shall forward the signed off drawings to the Owner's Representative who shall furnish B & W prints for final distribution to all Contractors and Subcontractors.

3.2 COORDINATION MEETINGS

A. During the coordination process, separate meetings apart from project meetings concerning the progress and schedules may be called by the Owner's Representative when required or at the request of one or more of the coordinating Contractors.

1. The Owner's Representative shall contact the Contractors and make all required arrangements, e.g. time, place, etc.

2. All Contractors shall place emphasis and importance on equipment purchases, so as to not delay approvals, shop drawings and the coordinated drawings.

B. Turn-around time for coordinated drawings is extremely critical and must be performed on an expedited basis.

1. The Owner's Representative shall prepare a schedule for time allotments for each Contractor for preparation of coordinated drawings and review so that rapid progress and adherence to the schedule may be achieved.

2. The MC, upon award of contract, shall immediately engage a Sheet Metal Subcontractor who shall then be directed to initiate the ductwork shop drawing and coordination process.

3.3 SCHEDULE OF SUBMISSIONS

A. The MC and SM shall commence the ductwork shop drawings within two (2) weeks after award of contract (or authorization to proceed).

B. The Sheet Metal Subcontractor and MC shall submit the coordinated ductwork shop drawings to the Owner's Representative for review and distribution within the time-frame and schedule as directed by the Owner's Representative.

C. After review of coordinated ductwork shop drawings by the Owner's Representative, corrections shall be made, if required, prior to transmitting to the Contractor and Subcontractors for their phase of the coordinated drawings process.

D. Turn-around time for each Contractor shall be two (2) weeks maximum.

E. Upon completion of the coordination process by all Contractors and Subcontractors as described above, they shall sign off on drawings indicating company, name, date of sign-off and signature of company representative.

Signatures shall be understood to verify that each Contractor has shown their respective work on the drawings and have resolved all points of conflict and interference with other Contractors and Subcontractors.

F. Completed signed off prints of coordinated drawings shall be transmitted to all Contractors as outlined above for construction and installation. Revised and recoordinated drawings may be required to attain approval for construction drawings. The Owner's Representative shall maintain completed coordinated mylar drawings or sepias in his files.

3.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

3.5 CLOSEOUT SUBMITTALS

A. RECORD AND “AS BUILT” DRAWINGS

1. Each Contractor, after completing his segment of the coordinated drawings, shall print copies of the completed drawings and maintain same for his records.

2. At the completion of the project and at the option of the Owner’s Representative, “As Built” corrections will be made to each mylar or sepia by each of the aforementioned Contractors and returned to the Owner’s Representative for the Owner’s permanent files and records.

3. These “As Builts” do not remove the obligation of “As Builts” and record drawings as outlined under other sections of the specifications unless the Owner’s Representative elects to do so.

END OF SECTION 260810

SECTION 260923 LIGHTING CONTROL EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Description of Work: Provide lighting control equipment as indicated.

C. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-4(b)9

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.4 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Lighting Control Equipment to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Lighting Control Equipment manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

PART 2 - PRODUCTS

2.1 OCCUPANCY SENSOR – CEILING MOUNT – ULTRASONIC

A. Temperature and Humidity resistant, ceiling mount application, with omni-directional ultrasonic detection only, 1,000 square feet coverage. Light level sensor not required. Solid state circuitry, volumetric coverage, with coverage pattern adjustable by lens selection. Detection shall be maintained when a person of average size moves at least 12 inches at an approximate speed of 12 inches per second.

B. Coverage: Minimum of 900 square feet, when mounted at 9 feet.

C. Time Delay: “Off” delay adjustable 15 seconds to 15 minutes. Coordinate exact time delay settings on a room by room basis with owners representative.

D. Mounting Provisions: Manufacturers standard, and/or field fabricated, as required.

E. Relay Modules: Separately mounted U.L. listed power supply consisting of transformer and contact closure relay. Power output of transformer to be 100 ma at 24 volts DC, capable of operating one or two sensors. Transformer primary voltage to be 120 or 277 volts AC as indicated or required.

F. Slave Modules: Where so indicated, for controlling additional lighting or other circuits from the same sensor(s) connected to a primary relay module.

G. Lighting Control Boxes: NEMA-1 steel enclosures, sized as required to house the indicated relay module(s) and slave module(s). Boxes to include steel barrier for mounting all relay d slave module(s), and segregating line voltage and control voltage wiring. Include engraved nameplate “Lighting Control Box”.

H. Acceptable Manufacturers: The Watt Stopper, Lutron and LC&D.

2.2 OCCUPANCY SENSOR WALL SWITCHES

A. General: Two-wire (no neutral connection), self-contained passive infrared technology, employing a temperature compensated dual element sensor and multi-faceted fresnel lens, designed for taking the place of a standard toggle switch, and compatible with solid-state lighting ballasts.

B. Coverage: Up to 750 square feet, 25 foot axial range, and a 170 degree field of view. Field of view to be adjustable to 60, 90 or 120 degrees via lens masking labels.

C. Adjustments: Auto-off time delay adjustable 2-15 minutes, and adjustable sensitivity. Coordinate actual time delay on a room by room basis with owners representative.

D. Controls: Manual-on, manual-off, and automatic-off.

E. Indicators: Red LED to indicate when unit is triggered; and audible warning tone to presignal automatic shutdown.

F. Voltage: 120 volts AC.

G. Load Rating: 600 volt-amperes ballast and incandescent load at 120 volts.

H. Acceptable Manufacturers: Lightolier Controls, The Watt Stopper and Lutron.

2.3 LIGHTING CONTROL CONTACTORS

A. 277 volt AC (all loads), 30 amp, number of poles lighting contactors as indicated on Drawings. Normally open,, mechanically held, 277 volt coil, with “Hand-Off Auto” selector switch, NEMA-3 enclosure with engraved nameplate “LIGHTING CONTROL”, interior mounting panel and hinged, lockable cover. Acceptable Manufacturers: Square D,GE or Westinghouse.

2.4 TIME SWITCHES

A. Two-channel, programmable, astronomic, seven-day digital time switch with 365-day holiday capability (16 single dates and 5 holiday blocks), and capable of 48 events per channel, per week. Unit to include automatic adjustment for daylight savings switchovers and leap years corrections, manual on-off override control for each channel, 72-hour battery backup, and NEMA-1 metal enclosure. Astronomic feature to be field adjustable for 10° - 60° northern or southern latitudes, and selectable to one or both channels, with adjustablbe1-99 minute offset from sunrise to sunset. Time switches to be suitable for operation to form a 120 or 277 volt power source, as indicated or required and comply with FL 917. Contacts to be rated 10 amp resistive, 7.5 amp inductive and 1/3 horsepower, at 120 volts AC, and 10 amp resistive at 277 volts AC. Acceptable Manufacturers: TorkParagon or Intermatic.

2.5 PHOTOSWITCHES

A. Photoswitches: Raintight 120 volt or 277 volt as indicated or required, with SPST contacts rated for 2000 watts, with field adjustable light level sensitivity (2-50FC), time delay, and sun-glare shield. Acceptable Manufacturers: Tork, Intermatic or Dayton.

PART 3 - EXECUTION

3.1 GENERAL

A. Install all equipment as indicated and as recommended by the equipment manufacturer. Use only one manufacturer for each type of equipment described in this Section.

3.2 OCCUPANCY SENSORS

A. Installation: Install wire and connect all sensors and related equipment per the manufacturer's written instructions. Adjust field of views, sensitivities and time delays, and set system configuration selector switches, etc. as indicated, directed or required for optimum control. Locate all relay modules and slave modules in lighting control boxes as indicated.

3.3 LIGHTING CONTROL CONTACTOR

A. Connect “Auto” position of relay H-O-A selector switches through photoswitch control contacts, and the “HAND” and off position to override the automatic control.

3.4 PHOTOSWITCH

A. Adjust sensitivity for proper operation.

3.5 TESTS

A. Test all equipment for proper operation. Correct/adjust as required.

3.6 OWNER INSTRUCTION

A. Provide factory authorized technician for final terminations and instruct the Owner's representative(s) in the operation and maintenance of each type of equipment. Minimum (8) hours on site for factory technician.

END OF SECTION 260923

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-3(h)

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 DESCRIPTION OF WORK

A. Provide all work and coordination for work indicated below and on the drawings and pay all associated costs for the electric service

B. Coordinate electrical service connections to components furnished by utility companies.

1. Coordinate installation and connection of exterior underground utilities and services, including provision for electricity metering components.

2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

3. Coordinate the installation of new transformer by minimizing the power outage to the existing service.

C. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.

D. Electrical Service: Primary electric service cables and 120/208 volts, 3 phase, 600A transformer shall be furnished and installed by Connecticut Light and Power (CL&P). There is a CL&P utility charge for installation and connection of primary cable from existing utility pole to new pad mounted transformer. Location of the transformer is indicated on the plans or as determined by the utility company. All the conduits and pull strings, transformer pad, grounding, secondary service, new meter socket and associated conduit shall be supplied and installed by the Contractor. The utility company shall supply the meter, CT's, test switch, and metering conductors. A charge of $5000.00 shall be included in the contract bid price. This amount also includes the service connections to the facility by the utility company.

E. All Contractors will include the amount of $5000.00 for utility service charges in the Contract Bid Price. If it is determined that different charges apply, the Contractor's bid will be adjusted to reflect the differential by construction order, provided that the Contractor provides all applicable written

billing documentation. The Contractor will be compensated only for the difference between the billed amount and the estimated amount. No additional Contractor markup will be allowed.

F. The Contractor shall call "Call Before You Dig!" at (800) 9224455, before any excavation takes place. Contractor shall coordinate excavation with paving operation.

1.4 SERVING UTILITY

A. The serving utility is Connecticut Light & Power. Service Consultant will be Brian Morgan 203-597-4233.

1.5 ELECTRIC SERVICE SOURCE

A. Electrical service is to be obtained as indicated.

1.6 EXISTING CONDITIONS

A. Field verify all existing conditions, and report any discrepancies.

1.7 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For all equipment furnished as part of the electric service indicate compliance with specified requirements and all utility company requirements. Written approval is required.

1.8 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide all products as specified and/or indicated.

PART 3 - EXECUTION

3.1 GENERAL

A. Prior to commencing work on the service, contact the serving utility and the governing municipal authorities to ascertain their latest standards and requirements. Obtain all applicable details, specifications and other requirements pertaining to the service for the project. The installation of all service equipment, components and wiring shall comply with the requirements of the serving utility and the National Electrical Code.

3.2 INSTALLATION

A. Direct buried primary conductors shall be routed in Schedule 40 PVC Conduit when below roadways, parking lots, sidewalks and when required by the serving Utility Company. If not indicated, the minimum depth shall be as specified in the NEC Table 300.5.

3.3 DIVISION OF WORK

A. Provide all work as indicated in the contract documents and as specified by the Utility Company standards.

END OF SECTION 262100

SECTION 262200 DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Description of Work: Provide dry type transformers as indicated.

C. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13. for credits 16a-38k-3(h), 16a-38k-4(b)4, 16a-38k-4(b)5

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

C. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.Shop Drawings: Indicating ratings, dimensions and features for each transformer and all accessories used on project.

D. Test Data: (for transformers of identical design to proposed units). Include: Losses at 0, 25, 50, 75, 100% rated load; percent regulation at 80% and 100% power factor; % X and % R values; maximum sound level of transformer in enclosure; and maximum hot spot and average temperature rise over 40ºC ambient.

1.4 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Dry Type Transformer to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Dry Type Transformer manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Transformers shall be UL listed and labeled, and meet all applicable NEMA and IEEE standards.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. General Electric; Siemens; Square D.

2.2 DRY TYPE TRANSFORMERS

A. Enclosure: Ventilated, drip-proof code gauge steel housing with bolted removable access panels, phosphatized and finished with corrosion inhibiting undercoat and ANSI-61 gray baked enamel. Transformers shall be suitable for mounting on floor or other substantial structure, except for 15 KVA size and smaller which shall be suitable for wall mounting.

B. Core and Coil: Constructed of continuous copper or aluminum windings and high grade non-aging, grain oriented silicon steel core laminations having high magnetic permeabilities and low hysteresis and eddy current losses. Core and coil of units rated 15 KVA or more shall be completely isolated from the enclosure using vibration absorbing mounts and shall have flexible grounding strap connected to the enclosure. Connections to primary and secondary bushings shall be made using fully rated flexible straps.

C. Insulation System: Minimum 220ºC temperature class.

D. Temperature Rise: Winding temperature rise by resistance limited to 115ºC referenced to 40ºC ambient temperature. Hot spot temperature shall not exceed 30ºC above winding temperature rise rating. Case temperature shall not exceed 35ºC above 40ºC ambient temperature.

E. Transformers shall be energy efficient, Energy Star® / NEMA TP-1 qualified.

F. Taps: Two 5% FCBN taps for transformer sizes below 30 KVA; and two 2-1/2% FCAN and four 2-1/2% FCBN taps for transformer sizes 30 KVA and larger; referenced to nameplate voltage.

G. Noise Levels: Less than ANSI standards.

H. Ratings: KVA rating, voltages, phases and configuration as indicated. Minimum impedance: 4.5%.

I. Shielding: Provide an electrostatic shield between primary and secondary windings grounded to a common point on the enclosure. Minimum attenuation required 100:1.

J. Nameplates: Per 260553 - Electrical Identification.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mounting: Install transformers on floors or walls, or suspend from building structure as indicated, with mounting provisions, supporting means and methods as required for the weights and types of building construction encountered, and in compliance with all building and seismic codes. All floor mounted transformers to be set on 3-1/2" high concrete housekeeping pads.

B. Conduit Connections: Make all conduit connections to transformer cases using flexible metal conduit.

C. Grounding: Comply with 260526 - Grounding.

D. Sound Dampening: Comply with manufacturer's instructions related to relaxing tension or removal of shipping hold down provisions on the sound dampening system.

E. Ventilation Openings: Do not obstruct transformer ventilation openings.

F. Taps: Set transformer taps for proper secondary voltage.

3.2 TESTING

A. Visual and Mechanical Inspections:

1. Compare equipment nameplate data with drawings and specifications.

2. Inspect physical and mechanical condition.

3. Verify that the unit is properly mounted and that all shipping brackets are removed.

4. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or UL 486A.

5. Verify that the transformer neutral and case are properly bonded to building steel or other grounding means.

B. Electrical Tests

1. Perform insulation-resistance tests winding-to-winding and each winding-to-ground with 1000V DC tester, to insure that there are no short circuits or grounds.
2. Verify proper phase rotation.

C. Test Reports

1. Provide test report, number of copies as indicated elsewhere.

END OF SECTION 262200

SECTION 262300 SWITCHGEAR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all HVAC work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. This Section includes metal-enclosed low-voltage power switchgear.

C. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5

a. The above HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product data for each component.

1. Features, characteristics, and ratings of individual power circuit breakers.

2. Time-current characteristic curves for overcurrent protective devices, including circuit breaker trip devices and fusible devices.

C. Shop drawings for each switchgear lineup. Include dimensioned plans, sections, and elevations. Show minimum clearances, installed devices, major features, and materials lists. Include the following:

1. Nameplate legends.

2. Size and number of conductors in each bus run, including phase, neutral, and ground conductors of main and branch buses.

3. Current ratings of buses.

4. Short-time and short-circuit ratings of switchgear assembly.

5. Utility company metering provisions.

6. Mimic Bus Diagram: Updated version of single-line diagram reflecting final switchgear load connections. Submit samples of colors for mini bus.

D. Wiring Diagrams: Single-line, elementary, and schematic diagrams of equipment to be supplied, differentiating between manufacturer-installed and field-installed wiring.

E. Manufacturer's certificates signed by manufacturer certifying the compliance with the manufacturer's qualification requirements specified in the "Quality Assurance" Article below. Upon request, submit evidence of manufacturing experience.

F. Product certificates signed by manufacturers of equipment certifying that their products comply with specified requirements.

G. Testing agency certificates signed by Contractor identifying the field testing agency and certifying that it and its field supervisor for the Project comply with the requirements specified in the "Quality Assurance" Article below.

H. Report of field tests and observations certified by the testing agency.

I. Maintenance data for components to include in Division 1 Section "Operating and Maintenance Data" and in Division 26 Section "Basic Electrical Requirements."

1.4 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Switchgear to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Switchgear manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: A company regularly engaged in manufacturing switchgear similar to those indicated for this Project and that have a record of successful in-service performance.

B. Testing Agency Qualifications: In addition to the requirements specified in Division 1 Section "Quality Control Services," the testing firm shall meet Occupational Safety and Health Administration (OSHA) criteria for accreditation of testing laboratories, Title 29, Part 1907, or shall be a full member company of the InterNational Electrical Testing Association (NETA).

1. Testing Firm's Field Supervisor Qualifications: A person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

D. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

B. Store so condensation will not form on or in switchgear units. Apply temporary heat, according to manufacturer's recommendation, within each section of switchgear, while switchgear is not in a space that is continuously controlled, to obtain specified service conditions.

C. Handle switchgear according to manufacturer's instructions. Use factory-installed lifting provisions.

1.8 EXTRA MATERIALS

A. Spare Fuses: Six of each type and rating of fuse used. Include spares for potential transformer fuses, control power fuses, and fuses and fusible devices for fused circuit breakers.

B. Spare Indicating Lights: Six of each type installed.

C. Touchup Paint: Three 0.5-pint (250-mL) containers of paint matching enclosure finish.

D. Undercoating Touchup: One container.

E. Contact Lubricant: One container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric Co.
2. Siemens Energy & Automation, Inc.
3. Square D Co.

2.2 SWITCHGEAR

A. Factory assembled and tested, and complying with the following standards:

1. IEEE C37.20.1.
2. NFPA 70 requirements for service entrance.

B. Product Selection for Restricted Space: The Drawings indicate maximum dimensions for switchgear equipment, including clearances between switchgear and adjacent surfaces and items. Switchgear assemblies having equal performance characteristics and complying with indicated maximum dimensions will be considered.

C. Unusual Service Conditions: Where indicated, provide switchgear assemblies designed for the following conditions:

1. Vertical Section Bus Size: IEEE C37.20.1, calculation assuming spare breakers and spaces for future breakers are fully equipped and carrying current at 100 percent of their maximum frame size current ratings.

2.3 RATINGS

A. Nominal System Voltage: 480/277 V, 60 Hz, 4 wire.

B. Main Bus Continuous: 4000 A.

1. Short-Time and Short-Circuit Current Ratings: Match rating of highest-rated circuit breaker in the switchgear assembly.

2.4 FABRICATION

A. Enclosure: Steel. Protect openings against falling dirt, water, and other substances.

B. Finish: IEEE C37.20.1, manufacturers standard gray finish over a rust-inhibiting primer on phosphatizing-treated metal surfaces.

C. Section barriers between main and tie circuit breaker compartments extend to the rear of the section.

D. Bus isolation barriers are arranged to isolate the line bus from the load bus at each main and tie circuit breaker.

E. Barriers isolate load cable connections from main horizontal buses.

F. Utility Metering Compartment: Conform to utility company requirements. Match and align with basic switchgear assembly.

G. Bus Transition and Incoming Line Pull Sections: Match and align with basic switchgear assembly.

H. Circuit Breaker Compartments: Equipped to house drawout power circuit breakers and fitted with hinged outer doors.

I. Removable hinged rear cover panels, secured by captive thumb screws, allow access to rear interior of switchboard.

J. Hinged Front Panels: Allow access to metering, accessory, and blank compartments.

K. Pull box on top of switchgear allows extra room for pulling cable.

1. Ventilation adequate to maintain air temperature in pull box within same limits as switchgear.

2. Set back from front to clear circuit breaker lifting mechanism.

3. Removable Covers: For top, front, and sides.

4. Bottom: Insulating, fire-resistant material with separate holes for cable drops into switchgear.

5. Cable Supports: Arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

L. Phase and Neutral Bus Material: Hard-drawn copper of 98-percent minimum conductivity, or tin-plated, high-strength, electrical-grade aluminum alloy.

1. Use copper for connecting circuit breaker line to copper bus.

M. Feeder Breaker Load Terminals: Silver-plated copper bus extensions equipped with pressure connectors for outgoing circuit conductors.

N. Ground Bus: Hard-drawn copper of 98-percent minimum conductivity, with pressure connector for feeder and branch circuit ground conductors.

1. Minimum Size: 1/4 inch by 2 inches (6 mm by 50 mm).

O. Supports and Bracing for Buses: Adequate strength for indicated short-circuit currents.

P. Contact Surfaces of Buses: Silver plated.

Q. Bus bars connect between vertical sections and between compartments. Cable connections not permitted.

R. Main Phase Buses, Neutral Bus, and Equipment Ground Bus: Uniform capacity the entire length of the assembly. Provide for future extensions from either end by means of predrilled boltholes and connecting links.

S. Neutral Disconnect Link: Arranged to permit connecting the switchgear assembly neutral bus to the common ground bus, with a bolted, uninsulated, 1/4-by-2-inch (6-by-50-mm) copper bus (main bonding jumper).

T. Bus Bar Insulation: Individual bus bars wrapped with factory-applied, flame-retardant tape or spray-applied, flame-retardant insulation.

1. Sprayed Insulation Thickness: 3 mils (0.08 mm), minimum.

2. Bolted Bus Joints: Insulate with secure joint covers that are easily removed and reinstalled.

3. Increase insulation thickness where bus bar clearance prior to insulation is less than required for bare bus.

2.5 COMPONENTS

A. Instrument Transformers: Conform to IEEE C57.13.

1. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.

2. Current Transformers: Ratios as indicated; burden and accuracy class suitable for connected relays, meters, and instruments.

3. Control Power Transformers: Dry type, in separate compartments for units larger than 3 kVA, including their primary and secondary fuses.

4. Current Transformers for Neutral and Ground Fault Current Sensing: Located as indicated, secondaries connected to ground overcurrent relays to provide selective tripping of bus tie and main breakers. Sizes and settings of main circuit breaker are coordinated with feeder breaker ground fault protection.

5. Zero-Sequence, Window-Type Current Transformers: Located and connected to provide selective ground fault relaying.

B. Multifunction Digital Metering Monitor: UL-listed or -recognized microprocessor-based unit suitable for 3- or 4-wire systems and with the following features:

1. Inputs from sensors or 5-A current transformer secondaries, and potential terminals rated to 600 V.

2. Switch selectable digital display of the following:

a. Phase currents, each phase, plus or minus 1 percent.

b. Phase-to-phase voltages, 3 phase, plus or minus 1 percent.

c. Phase-to-neutral voltages, 3 phase, plus or minus 1 percent.

d. 3-phase real power, plus or minus 2 percent.

e. 3-phase reactive power, plus or minus 2 percent.

f. Power factor, plus or minus 2 percent.

g. Frequency, plus or minus 0.5 percent.

h. Integrated demand, with demand interval selectable from 5 to 60 minutes, plus or minus 2 percent.

i. Accumulated energy, in megawatt hours (joules), plus or minus 2 percent; stored values unaffected by power outages up to 72 hours.

3. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

C. Relays: Conform to IEEE C37.90, types and settings as indicated; with test blocks and plugs.

D. Surge Arresters: Distribution class, metal-oxide varistor type. Comply with NEMA LA 1 and IEEE C62.11.

1. Install in cable termination compartments and connect in each phase of circuit.
2. Coordinate rating with circuit voltage.

E. Provision for Future Devices: Compartments equipped with rails, mounting brackets, supports, necessary appurtenances, and bus connections with ampacities, as indicated or as assigned on shop drawings for future insertion of circuit breakers in compartments indicated for future circuit breakers or space.

F. Fungus Proofing: Permanent fungicidal treatment for switchgear interior, including instruments and instrument transformers.

G. Control Power Supply: Control power transformer supplies 120-V control circuits through secondary disconnect devices. Include the following features:

1. Two control power transformers in separate compartments with necessary interlocking relays, each transformer connected to the line side of the associated main circuit breaker.

2. Secondaries connected through a relay or relays to control bus to effect an automatic transfer scheme.

3. Secondaries connected through an internal automatic transfer switch to switchgear control power bus.

H. Control Power Fuses: Primary and secondary fuses provide current-limiting and overload protection.

I. Control Wiring: Factory installed, complete with bundling, lacing, and protection; and complying with the following:

1. Flexible conductors for size 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2. Conductors sized according to NFPA 70 for the duty required.

2.6 CIRCUIT BREAKERS

A. Description: Conform to IEEE C37.13.

B. Ratings: As indicated for continuous, interrupting, and short-time current ratings for each circuit breaker; voltage and frequency ratings same as switchgear.

C. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with the following features:

1. Normal Closing Speed: Independent of both control and operator.
2. Stored-Energy Mechanism: Electrically charged, with optional manual charging.
3. Operation Counter.

D. Trip Devices: Solid-state, overcurrent trip device system consisting of 1 or 2 current transformers or sensors per phase, a release mechanism, and the following features:

1. Functions: Long-time delay, short-time delay, and instantaneous trip functions, independent of each other in both action and adjustment.

2. Temperature Compensation: Ensures accuracy and calibration stability from minus 5□C to plus 40□C.

3. Field adjustable time-current characteristics.

4. Current adjustability effected by changing dial settings and rating plugs on trip units or sensors on circuit breakers or a combination of these methods.

5. Three bands, minimum, for long-time- and short-time-delay functions; marked “minimum,” “intermediate,” and “maximum.”

6. Pickup Points: 5 minimum, for long-time- and short-time-trip functions. Short-time-trip function equipped for switchable I-squared-t operation.

7. Pickup Points: 5 minimum, for instantaneous trip functions.

8. Ground fault protection with at least 3 short-time-delay settings and 3 trip-time-delay bands. Adjustable current pickup. Arranged to provide protection for the following:

a. 4-wire circuit or system.

9. Trip Indication: Labeled, battery-powered lights or mechanical targets on trip device to indicate type of fault.

E. Auxiliary Contacts: For interlocking or remote indication of breaker position, with spare auxiliary switches in addition to other auxiliary switches required for normal breaker operation, quantity as

indicated. Each consists of 2 Type “a” and 2 Type “b” stages (contacts) wired through secondary disconnecting devices to a terminal block in the stationary housing.

F. Padlocking Provisions: For installing at least 3 padlocks on each breaker to secure its enclosure and prevent movement of the drawout mechanism.

G. Operating Handle: One for each breaker capable of manual operation.

H. Undervoltage Trip Devices: Adjustable time-delay and pickup voltage.

I. Shunt-Trip Devices: Where indicated.

2.7 ACCESSORIES

A. Accessory Set: Tools and miscellaneous items required for circuit breaker and switchgear test inspection, maintenance, and operation. Includes racking handle to manually move the breaker between CONNECTED and DISCONNECTED positions. Portable test set permits testing of all functions of circuit breaker solid-state trip devices without removal from switchgear. Relay and meter test plugs are suitable for testing switchgear meters and switchgear class relays.

B. Spare Fuse Cabinet: Identified and compartmented steel box, or cabinet with lockable door.

2.8 IDENTIFICATION

A. Identification Materials: Refer to Division 16 Section “Electrical Identification.” Identify units, devices, controls, and wiring.

B. Compartment Nameplates: Engraved laminated plastic or metal nameplate for each compartment, mounted with corrosion-resistant screws.

C. Mimic Bus: Continuous mimic bus applied to front of switchgear. Arranged in single-line diagram format, using symbols and lettered designations consistent with the approved final mimic bus diagram. Mimic bus segments coordinated with devices in switchgear sections to which applied, to produce a concise visual presentation of the principal switchgear components and connections.

1. Medium: Painted graphics, as approved.
2. Color: Contrasting with the factory-finish background.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Manufacturer’s Field Services: Arrange and pay for the services of a factory-authorized service representative to supervise the field assembly, the connection of switchgear, and a minimum of 2 working days of pretesting and adjustment of switchgear components.

B. Locations and Layout: The exact relative locations and physical layout of equipment and components may be varied as required to suit manufacturer’s design and as approved, provided the required functions and operations are accomplished; however, follow the identification of the units indicated on Drawings exactly to facilitate checking and building maintenance procedures.

C. Anchor each switchgear assembly to at least two 4-inch (100-mm), channel-iron floor sills arranged according to the manufacturer’s recommendations. Attach by tack welding or bolting.

1. Sills: Select to suit the switchgear. Level and grout flush into the floor or housekeeping pad.

2. Concrete Pad: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend the pad no more than 2 inches (50 mm) in all directions beyond the maximum dimensions of the switchgear except as otherwise indicated. Comply with Division 3 Section "Cast-in-Place Concrete."

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, brackets, and temporary blocking of moving parts from switchgear units and components.

E. Diagram and Instructions: Frame under clear acrylic plastic on the front of the switchgear.

1. Operating Instructions: Printed basic instructions for switchgear, including control and key interlocking sequences and emergency procedures.

2. Storage for Manual: Include a rack or holder for a copy of the operation and maintenance manual in the vicinity of the operating instructions.

3. System Power Riser Diagrams: Depicts power sources, feeders, distribution components, and major loads. Include as-built data regarding the low-voltage power switchgear and connections as follows:

a. Frame size of each circuit breaker.
b. Trip rating for each circuit breaker.
c. Conduit and wire size for each feeder.

F. Mount spare fuse cabinet in the switchgear room where indicated.

3.2 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs as specified in Division 16 Section "Electrical Identification."

3.3 GROUNDING

A. Connect switchgear ground bus to common building ground indicated on Drawings.

3.4 CONNECTIONS

A. Tighten bus joint, connector, and terminal bolts according to the manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will employ and pay an independent testing agency to perform specified field quality-control testing.

B. Testing Agency: Arrange and pay for the services of an electrical testing agency according to the requirements of Division 1 Section "Quality Control Services" to perform inspection and tests on switchgear, components, and accessories.

C. Test Procedure: Conform to the following:

1. Test Objectives: To assure switchgear installation is operational within industry tolerances, is installed according to the specified requirements, and is suitable for energizing.

2. Compliance: Make inspections and tests according to applicable IEEE C37.20.1, applicable requirements of NETA ATS, and the requirements below:

3. Labeling: Upon satisfactory completion of tests, apply an initialed and dated "Tested" label to tested components.

4. Schedule tests at least 1 week in advance of test commencement.

5. Reports: Submit written report of observations and tests. Report defective materials and workmanship.

6. Protective Device and Relay Settings: Verify that settings given on Drawings are appropriate for final system configuration and parameters. Where discrepancies are found, recommend final settings for approval before making final adjustments.

D. Visual and Mechanical Inspections: Perform the following:

1. Compare nameplates of equipment and detailed components with single-line diagram and specified requirements, and report discrepancies.

2. Check for proper anchorage, required clearances, physical damage, and proper alignment of switchgear and components.

3. Inspect all doors, panels, and sections for paint, dents, scratches, fit, and missing hardware.

4. Verify that fuse and circuit breaker sizes, types, and ratings conform to Contract requirements. Include control power and potential, control power transformer fuses, and fuses for fused circuit breakers.

5. Verify that ratios of current, potential, and control power transformers correspond to Drawings.

6. Inspect bus connections for high resistance. Use low-resistance ohmmeter or check tightness of bolted bus joints by using a calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.

7. Test electrical and mechanical interlock systems for proper operation and sequencing. Make closure attempts on locked-open devices. Make opening attempts on locked-closed devices. Attempt key exchanges with devices in exchange-preventing positions.

8. Clean switchgear interior and exterior using manufacturer's approved methods and materials.

9. Inspect insulators for evidence of physical damage and contaminated surfaces.

10. Verify proper barrier and shutter installation and operation.

11. Verify proper lubricant on current-carrying moving parts.

12. Verify appropriate lubrication on moving and sliding surfaces.

13. Exercise active components.

14. Inspect mechanical-indicating devices for proper operation.

E. Electrical Tests: Perform the following:

1. Current transformers test according to ANSI standards for field tests.

2. Ground-resistance tests according to ANSI standards.

3. Insulation-resistance tests on each bus section, phase-to-phase, and phase-to-ground for 1 minute.

   a. Test Voltage: 1000-V dc.
   b. Minimum Resistances: 100 megohms.

4. Overpotential test on each bus section, each phase-to-ground, for 1 minute. Use manufacturer's recommended test potential.

5. Insulation-Resistance Test on Control Wiring: Disconnect solid-state components first.

6. Control Component and Wiring Performance Test: Use elementary diagrams to identify control devices. Verify satisfactory performance of wiring and devices.

7. Secondary Voltage Energization Test: Energize control power and potential circuits. Check voltage levels at each point on terminal boards and at each terminal on devices.

8. Current injection test on the entire current circuit in each section of switchgear to obtain a minimum of 1-A flow in the secondary circuit.

   a. Use primary injection where possible.
   b. Use secondary injection where primary injection is impractical.
   c. Measure current at each device.

9. Meter Accuracy Test: Verify multipliers and accurate measurement.

F. Control Power and Potential Transformer Tests: Perform the following:

1. Insulation-Resistance Tests: Measure from winding-to-winding and winding-to-ground at room temperature. Test voltages and resistances.

2. Secondary Wiring Integrity Test: Disconnect transformer at secondary terminals and connect secondary wiring to proper secondary voltage. Check potential at all devices.

3. Secondary Voltage Verification: Energize primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.

G. Circuit Breakers and Drawout Mechanisms, Visual and Mechanical Inspection: Perform the following:

1. Check for Damage: Include arc chutes.

2. Inspect alignment and grounding of breakers and carriages.

3. Perform mechanical operational tests on circuit breaker, operating mechanism, and drawout carriage.

4. Measure critical dimensions as recommended by the manufacturer. Include contact gap and wipe. Make adjustments as needed.

5. Check Tightness of Bolted Connections: Use calibrated torque wrench. Refer to manufacturer's recommendations for proper torque values.

H. Circuit Breaker Electrical Tests: Perform the following:

1. Contact-resistance test or measurement of millivolt drop across contacts at rated current. Compare contact resistance or millivolt drop values of adjacent poles and of similar breakers. Deviations of more than 50 percent are not acceptable.

2. Breaker Travel and Velocity Analysis.

3. Trip circuit breaker by operation of each protective device.

4. Insulation-Resistance Tests: Pole-to-pole, pole-to-ground, and across open poles at 1000-V minimum.

5. Insulation-resistance test of control wiring at 1000-V dc. Do not perform this test on wiring connected to solid-state relays.

6. Use primary current injection to check performance characteristics of trip units. Trip characteristics not falling within manufacturer's published time-current characteristic tolerance bands when adjusted to approved parameters are not acceptable. Perform the following:

   a. Determine minimum pickup current acceptable, per manufacturer's instructions.
   b. Determine long-time-delay time at 300-percent pickup current.
   c. Determine short-time-pickup current and corresponding delay time.
   d. Determine ground fault current pickup and corresponding delay time.
   e. Determine instantaneous-pickup current value.
   f. Verify trip unit reset characteristics.
   g. Make adjustments for final settings.

7. Activate auxiliary protective devices such as ground fault and undervoltage relays to verify operation of shunt-trip devices.

8. Check charging motors for proper operation of motor, mechanism, and limit switches.

9. Check operation of electrically operated breakers according to manufacturer's instructions.

10. Check safety devices for operation and sequence. Make closing attempts on locked-open and opening attempts on locked-closed devices, including movable barriers and shutters.

I. Miscellaneous Calibration and Checks: Perform the following:

1. Calibrate ammeters and voltmeters at midscale.
2. Calibrate watt-hour and demand meters to 0.5 percent and verify meter multipliers.
3. Check phasing of alternate supply sources to the same bus.

J. Retest: Correct deficiencies identified by tests and observations and completely retest switchgear. Verify by the system tests that the total assembly meets specified requirements.

3.6 ADJUSTING AND CLEANING

A. Upon completion of installation, inspect interior and exterior of switchgear. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars on finish to match original finish.

3.7 COMMISSIONING

A. Infrared Scanning: After Substantial Completion, but not more than 2 months after Final Acceptance, perform an infrared scan of switchgear assembly. Make bus joints and connections accessible to a portable scanner and perform scanning during the period of normal working load as advised by Owner.

B. Follow-Up Infrared Scanning: Perform 1 additional follow-up infrared scan at same locations as before, 11 months after the date of Substantial Completion.

C. Instrument: Use an infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide calibration record for scanning device used for electrical distribution equipment.

D. Record of Infrared Scanning: Prepare a certified report identifying all connections checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.8 DEMONSTRATION

A. Training: Arrange and pay for the services of factory-authorized service representatives to demonstrate switchgear and train Owner's maintenance personnel.

B. Training: Conduct a minimum of 1 day's training in operation and maintenance as specified under "Instructions to Owner Employees" in the Division 1 Section "Project Closeout." Include both classroom training and hands-on experience in safety precautions, equipment operation, and maintenance procedures.

C. Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION 262300

SECTION 262416 (OPS) – PANELBOARDS (OFF-SITE PUMP STATION NO. 2)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816, Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS

B. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

C. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

D. Qualification Data: For qualified testing agency.

E. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

G. Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manual form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR-CLOSEOUT DOCUMENTS.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards.

1.6 COORDINATION

A. Coordinate layout and installation of panelboards and components, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces.

B. Enclosures: Flush- and surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Outdoor Dry and Clean Locations: NEMA 250, Type 3R.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

4. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

C. Incoming Mains Location: Top and bottom.

D. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Compression type.
3. Ground Lugs and Bus-Configured Terminators: Compression type.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.

I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only as shown on the plans.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 407 NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NECA 407 NEMA PB 1.1.

B. Mount top of trim 90 inches above finished floor unless otherwise indicated.

C. Mount panelboard cabinet plumb and rigid without distortion of box.

D. Install overcurrent protective devices and controllers not already factory installed.

E. Install filler plates in unused spaces.

F. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Panelboards will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.

4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

END OF SECTION 262416 (OPS)

SECTION 262416 PANELBOARDS AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all HVAC work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Description of Work: Provide branch circuit panelboards, and/or distribution panels and circuit breakers as indicated.

C. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5

a. The above HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Shop Drawings: On 8-1/2" x 11" sheets, indicating panelboard identification, short circuit rating, bus rating (volts, phase, amps), box dimensions, quantities and ratings of overcurrent protective devices (volts, amps, poles, RMS symmetrical amperes interrupting capacity), details of panel covers and fastening, locks and latches, and all special modifications of each panel (e.g. shunt-trip breakers, ground busses, barriers, contactors). For individual circuit breakers, include enclosure description.

1.4 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Panelboards and Circuit Breakers to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Panelboards and Circuit Breakers see manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. General Electric; Siemens/ITE; Square D.

2.2 PANELBOARDS

A. General: Panelboard rating, mains, mounting, and complement of breakers to be as indicated on the Panelboard Schedules.

B. Cabinet Rough-In Boxes: Code gauge galvanized steel, with inturned flanges on all sides of front, and minimum 20" wide. For panelboards with gutter taps, provide oversized cabinets as required for adequate gutter space. For double-tub panelboards, provide cabinets of identical height.

C. Panelboard Front Covers:

1. General: Dead front, sheet steel, with rust inhibitive primer and baked light grey enamel or lacquer inside and out for surface mounted panelboards, and with non-glossy prime finish, suitable for final finish for flush mounted panelboards. Trim for flush panelboards to overlap box by at least 3/4" all around.

2. Surface Mounted Panelboards: “Door-in-door” type covers with two doors for access into panels: a standard door and an outer door with minimum clear access into panel gutters of 2.5" on sides and 4.0" at top and bottom. Doors over protective devices with hinges concealed and welded to the back of the door and cover with door stops on the other three sides. Provide NEMA 3R type enclosure for panels mounted exterior to building.

3. Flush Mounted Panelboards: “Door-in-door” type covers with two doors for access into panels: a standard door and an outer door with minimum clear access into panel gutters of 2.5" on sides and 4.0" at top and bottom.

D. Latches:

1. Metallic, flush type with lock. Non-metallic, non-flush type latches or catches will not be acceptable.

2. Vault handle with 3 point catch: Provide for doors over 48" high.

E. Interiors and Bussing:

1. Panelboard Assemblies: Removable and with provisions for front trim adjustment. Panels to be designed so that removal of any branch circuit device does not disturb adjacent devices.

2. Mains: Where no main overcurrent protective devices are scheduled, provide panelboards with main lugs only, and sub-feed or through-feed lugs when indicated. Main lugs with anti-turn feature.

3. Bussing: Copper only. Bussing to be arranged for alternating phase connection of branch devices, all spaces equipped to receive branch circuit devices. Phase bus ampacity as indicated, and with neutral bussing having ampacity at least equal to phase bus ampacity. Provide box lugs or screw terminals for each conductor terminated plus not less than five spares.

4. Equipment Ground Bus (Copper Only): In each panel, securely fastened to inside of panelboard box near bottom of enclosure. For branch circuit panelboards provide terminals

for at least (20) #14-8 conductors and a lug for the feeder equipment grounding conductor. For distribution panels provide terminals for all grounding conductors present, plus at least 25% spares.

F. Short Circuit Ratings: As indicated (minimum). Each panelboard shall be labeled with the required short circuit rating, taking into account the bus bracing and overcurrent protective device interrupting ratings. All devices shall be fully rated. Lower rated overcurrent protective devices based on series ratings with upstream devices will not be acceptable.

G. Panelboard Types:

1. Branch Circuit Panelboards: Two-row, circuit breaker type.
2. Distribution Panels: Circuit breaker type.

2.3 MOLDED CASE CIRCUIT BREAKERS

A. General: Bolt-in type, indicating open, closed, or trip by handle position, with common trip for all poles, trip free toggle mechanism, long time and instantaneous tripping characteristics, and minimum RMS symmetrical interrupting capacities of: 10,000A for all breakers in 208/120V panelboards; 14,000A for all breakers in 480/277V panelboards. Provide breakers with higher ratings where indicated or necessary to meet required panel short circuit ratings.

B. Panelboard Mounted:

1. Breakers to be Added to Existing Panelboards or Equipment: Same manufacturer, type and interrupting rating as for the existing breakers in same panelboard or equipment, unless indicated otherwise.

2. Branch breakers in branch circuit panelboards to be arranged in the order as indicated in the panelboard schedules, unless approved otherwise.

C. Individually Mounted:

1. Provide individually mounted circuit breakers where indicated, with NEMA-1 enclosures unless indicated otherwise.

2.4 NAMEPLATES AND CIRCUIT IDENTIFICATION

A. Nameplates per 260553 - Electrical Identification.

B. Plastic covered circuit directory card mounted on the inside of the panel front covers, with plastic protectors.

PART 3 - EXECUTION

3.1 CABINET INSTALLATION

A. As recommended by the manufacturer, secured to building structure or to steel framing, independent of conduits and raceways.

B. Surface Mounted Cabinets: Supported by at least 4 fasteners with spacing not to exceed 30 inches.

C. Flush Mounted Cabinets: Supported by the wall construction wherever possible.

D. Operation: Verify that all breakers switch properly.

3.2 MOUNTING HEIGHT

A. General: 78" from the top of the cabinet to the finished floor, except that 8" of clearance from the cabinet bottom to the floor shall be maintained unless doing so would exceed the maximum 6'-6" disconnect height allowed by the NEC.

B. Masonry Wall Joints: Even with the top of flush mounted panelboards.

3.3 CLOSURE PLATES

A. Cover all unused overcurrent device spaces.

3.4 FLUSH TRIMS

A. Paint (or arrange for painting) separately from related wall surfaces so that future removal of cover does not damage wall finish.

3.5 SPARE RACEWAYS

A. For each flush mounted panelboard, provide (4) 3/4 inch raceways extending into the ceiling cavity at an accessible location. Terminate each raceway with a cap end, and tag capped end to indicate "Spare Use."

3.6 IDENTIFICATION

A. Refer to 260553 - Electrical Identification.

3.7 PANELBOARD SCHEDULES

A. Refer to the Panelboard Schedules that follow, or that are on the Drawings. Final panelboard schedules shall be typed with date, contractors name and telephone number.

END OF SECTION 262416

SECTION 262713 (OPS) - ELECTRICITY METERING (OFF-SITE PUMP STATION NO. 2)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section includes equipment for electricity metering by utility company.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816, Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS

B. Product Data: For each type of product indicated.

C. Shop Drawings: For electricity-metering equipment.

1. Dimensioned plans and sections or elevation layouts.
2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Receive, store, and handle modular meter center according to NECA 400.

1.7 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:

1. Comply with requirements of utilities providing electrical power services.
2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.
3. A Charge of $1000 shall be included in the Contract Bid Price. This amount includes the service connections to the Facility by the Utility Company.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

A. Meters will be furnished by utility company.

B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.

C. Meter Sockets: Comply with requirements of electrical-power utility company.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

3.2 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.
2. Equipment Identification Labels: Adhesive film labels with clear protective overlay.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:
1. Turn off circuits supplied by metered feeder and secure them in off condition.

2. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
3. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.

B. Electricity metering will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 262713 (OPS)

SECTION 262713 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all ELECTRICAL work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Section includes equipment for electricity metering by utility company and electricity metering by Owner .

1.3 DEFINITIONS

A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For electricity-metering equipment.

1. Dimensioned plans and sections or elevation layouts.

2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Electrical Metering to be included in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Electrical Metering specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

C. Operation and Maintenance Data. include the following:

1. Application and operating software documentation.

2. Software licenses.

3. Software service agreement.

4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Receive, store, and handle modular meter center according to NECA 400.

1.9 COORDINATION

A. Electrical Service Connections: Coordinate electrical service connections to components furnished by utility companies.

1. Coordinate installation and connection of exterior underground utilities and services, including provision for electricity metering components.

2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

3. Coordinate installation of new transformer by minimizing the power outage to the existing service.

B. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.

C. Electrical Service: Primary electric service cables and service transformer shall be furnished and installed by Connecticut Light and Power (CL&P). There is a CL&P utility charge for the installation and connection of the primary cable from existing utility pole to new pad mounted transformer. Location of the transformer is indicated on the plans or as determined by the utility company. All the conduits and pull strings, transformer pad, grounding, secondary service, new meter socket and associated conduit shall be supplied by the contractor. The utility company shall supply the meter, CT's, test switch and metering conductors. A charge of $5000.00 shall be included in the contract bid price. This amount also includes the service connections to the facility by the utility company.

D. All contractors will include the amount of $5000.00 for the utility service charges in the contract bid price. If it is determined that different charges apply, the contractors bid will be adjusted to reflect the differential by construction order, provided that the Contractor provides all written billing documentation. The Contractor will be compensated only for the difference between the billed amount and the estimated amount. No additional Contractor mark-up will be allowed.

E. The contractor shall call "Call Before You Dig" at (800)922-4455, before any excavation takes place. Contractor shall coordinate excavation with paving operation.

1.10 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade his computer equipment if necessary.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

A. Main meter will be furnished by utility company.

B. Current-Transformer Cabinet: Comply with requirements of electrical-power utility company.

C. Meter Sockets: Comply with requirements of electrical-power utility company.

D. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

a. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
b. Siemens Energy & Automation, Inc.
c. Square D; a brand of Schneider Electric.

3. Comply with requirements of utility company for meter center.

4. Housing: NEMA 250, Type 1enclosure.

5. Minimum Short-Circuit Rating: 100,000 A symmetrical at rated voltage.

6. Main Disconnect Device: Circuit breaker, series-combination rated for use with downstream feeder and branch circuit breakers.

a. Identification: Complying with requirements in Section 260553 "Identification for Electrical Systems" with legend identifying tenant's address.

b. Physical Protection: Tamper resistant, with hasp for padlock.

7. Meter Socket: Rating coordinated with indicated feeder circuit rating.

2.2 EQUIPMENT FOR ELECTRICITY METERING BY OWNER

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

1. E-Mon; a division of Hunt Power.
2. National Meter Industries.
3. Square D; a brand of Schneider Electric.

B. General Requirements for Owner's Meters:

1. Comply with UL 1244.

2. Enclosure: NEMA 250, Type 1 minimum, located where indicated on the Contract Documents.

3. Identification: Comply with requirements in Section 260553 "Identification for Electrical Systems."

4. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.

5. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.

a. Type: solid core.

6. Building Automation System (BAS) Interface: One digital KY pulse to a user-definable increment of energy measurement. Match signal to BAS input and arrange to convey the instantaneous, integrated, demand level measured by meter to provide data for processing and possible programmed demand control action by destination system.

C. Kilowatt-hour Meter: Electronic single- and three-phase meters, measuring electricity used.

1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.

2. Display: LCD with characters not less than 0.25 inch high, indicating accumulative kilowatt-hours and current kilowatt load. Retain accumulated kilowatt-hour in a nonvolatile memory, until reset.

D. Kilowatt-hour/Demand Meter: Electronic single- and three-phase meters, measuring electricity use and demand. Demand shall be integrated over a 15-minute interval.

1. Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated for its application.

2. Display: LCD with characters not less than 0.25 inch high, indicating accumulative kilowatt-hours, [current time and date, current demand, and time and date of historic peak demand. Retain accumulated kilowatt-hour and historic peak demand in a nonvolatile memory, until reset.

E. Data Transmission Cable: Transmit KY pulse data over Class 1 control-circuit conductors in raceway. Cable type as indicated by manufacturer.

F. Software: PC based, a product of meter manufacturer, suitable for monitoring usage of multiple meters throughout facility.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install meter furnished by utility company and meters where indicated on Contract Documents. For utility company meter, install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

C. For all other meters indicated, provide conduit, wire, current sensors, etc. as recommended by manufacturer.

3.2 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Connect a load of known kilowatt rating to a circuit supplied by metered feeder.

2. Turn off circuits supplied by metered feeder and secure them in off condition.

3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.

4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.

B. Electricity metering will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 262713

SECTION 262726 WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Description of Work: Provide wiring devices and accessories as indicated.

C. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13.

2. HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.4 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Wiring Devices to be included in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Wiring Devics specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

PART 2 - PRODUCTS

2.1 GENERAL

A. All devices shall be UL-listed and meet all applicable ANSI, FS and NEMA standards.

2.2 DEVICE COLOR

A. As selected by Architect, Engineer or Owner.

2.3 GENERAL-USE SWITCHES

A. 20 amp, 120-277 volt, A.C. only, toggle type, and single pole, double pole, three-way or four-way as indicated.

B. Acceptable Manufacturers: Leviton;; Hubbell; Pass and Seymour.

2.4 KEY SWITCHES

A. Same as above, except operated by keyed cam lock. Furnish at least two keys per key switch.

B. Acceptable Manufacturer: Pass and Seymour; Leviton and Hubbell.

2.5 DIMMER SWITCHES

A. General: All dimmer switches must be compatible with the dimming ballast that it is controlling.

B. Incandescent Dimmers (120 Volts): Solid-state type, suitable for 120 volts incandescent control, with linear slide control, positive off position, high end trim, RFI filtering, circuitry that eliminates lamp flickering, single-pole or three-way switching as indicated, and matching finish for faceplates and slide controls. Sizes 600 watt to 2000 watt as indicated. Provide 1500 watt size unless indicated otherwise. Acceptable Manufacturer: Lutron, Leviton and Wattstopper.

C. Fluorescent Dimmers (120 Volts): Solid-state type, suitable for 120 volts fluorescent control, with linear slide control, positive off position, high end trim, RFI filtering, circuitry that eliminates lamp flickering, single-pole or three-way switching as indicated, and matching finish for faceplates and slide controls. Sizes 600 watt to 2000 watt as indicated. Provide 1500 watt size unless indicated otherwise. Acceptable Manufacturer: Lutron “NOVA” series, Wattstopper and Leviton.

2.6 GENERAL-USE RECEPTACLES

A. NEMA 5-20R configuration, 20 amp, 125 volt, A.C., duplex type as indicated, with wrap-around steel strap attached to back of receptacle and securely anchored into receptacle body near receptacle face, and with automatic grounding feature.

B. Acceptable Manufacturers: Leviton; Hubbell; Pass and Seymour.

2.7 GFI RECEPTACLES

A. Ground fault circuit interrupter, feed through, duplex receptacle, NEMA 5-20R configuration, 20 amp, 125 volt A.C. with solid-state ground-fault sensing and 5 MA trip level.

B. Acceptable Manufacturers: Leviton; Hubbell; Pass and Seymour.

2.8 SPECIAL RECEPTACLES

A. As indicated on the drawings by ratings and/or NEMA configuration. Furnish to the Owner, a matching 10' cord and plug set for each special receptacle. Provide submittals for each special receptacle type indicated.

B. Acceptable Manufacturers: Leviton; Hubbell; Pass and Seymour.

2.9 HAZARDOUS LOCATION DEVICES (CLASS I, DIVISION 1 and CLASS 1, DIVISION 2)

A. Devices approved for use in the specific classification in accordance with NEC Article 500.

B. Receptacles: NEMA 5-20R, dead front, delayed action circuit breaking type. Provide two matching NEMA 5-15P plugs for each receptacle and turn over to Owner.

C. Acceptable Manufacturers: Crouse-Hinds “ENR” & “ENP” Series, Leviton or Hubbell.

2.10 EMERGENCY POWER OFF (EPO) PUSHBUTTONS

A. Oil-tight, normally open, maintained contact pushbutton with red jumbo mushroom head and contacts rated at least 5 amps at 120 volts. Include stainless steel faceplate engraved with “EMERGENCY POWER-OFF” and suitable back box.

B. Acceptable Manufacturers: Square D Class 9001, Leviton or Hubbell..

2.11 COVERPLATES

A. General: Number of gangs, and openings to suit the number and type of devices.

B. General Use: Struck-up type, minimum .032" thick Type 430 stainless steel with U.S. #32D satin finish.

C. Dimmer Switch Coverplates: Plastic with no visible seams or screws, minimum 0.6" thick, white finish.

D. Weatherproof Coverplates: Suitable for the device indicated and type of outlet box used, cast aluminum or lexan. Receptacles installed in damp or wet locations shall comply with NEC 410-57.

E. Acceptable Manufacturers: Leviton, Hubbell and Lutron.

2.12 SURFACE METAL RACEWAYS AND MULTIOUTLET ASSEMBLIES

A. All components shall be UL listed, and be supplied from one of the following: Wiremold, Hubbell and Panduit.

PART 3 - EXECUTION

3.1 MANUFACTURERS

A. Use only one manufacturer for all switches and general use receptacles. Use only one manufacturer for each type of device.

3.2 GENERAL

A. Switches: Install single pole switches so that the circuit is on when the handle is up.

B. Receptacles: Install receptacles with ground pin up where vertically mounted, and on left when horizontally mounted.

C. Surface metal raceways and multioutlet assemblies shall be installed per the NEC Articles 352 and 353, respectively.

3.3 GFI RECEPTACLES

A. For each receptacle designated or indicated to be “GFI,” provide a GFI receptacle. Do not substitute general use receptacle with feed-through GFI protection from upstream GFI receptacle. Do not use feed-through feature of any GFI receptacle.

3.4 CASEWORK AND WOODWORK

A. Do not cut openings for devices in casework or woodwork. Coordinate sizes and locations of cutting with casework or woodwork supplier. Furnish and install all electrical items indicated and necessary, except as noted. Conceal raceways and outlet boxes unless indicated otherwise.

3.5 GANGING

A. Where devices are shown adjacent (e.g. bank of light switches), mount all such adjacent devices under one multi-gang coverplate, unless indicated otherwise.

3.6 COVERPLATE INSTALLATION

A. Install coverplates tight to wall, plumb, and level. Install receptacles so that device face is flush with or slightly ahead of coverplate face minimum of 0.015 in (381 micrometers). Install blank fillers in coverplate openings not used. Grout or caulk as required to provide watertight seal for weatherproof coverplates.

3.7 CIRCUIT IDENTIFICATION

A. Refer to 260553- Electrical Identification.

END OF SECTION 262726

SECTION 262813 FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Description of Work: Provide fuses as indicated or required. Fuses included in this Section are rated 600V AC and below.

C. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13.

2. HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Manufacturer's descriptive literature indicating fuse type and ratings, time-current curves, and peak current let-through for current limiting fuses. Supply data for each type of fuse. Different current ratings of the same type fuse may appear on the same sheet(s).

C. Product Data: When indicated, manufacturer's descriptive literature for the spare fuse cabinet.

1.4 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Fuses include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For fuses provide manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 EXTRA MATERIALS

A. For each fuse size and type used on the project, provide one spare fuse for every ten installed, but not less that six of each size.

PART 2 - PRODUCTS

2.1 GENERAL

A. All fuses shall be UL Listed, and applied as indicated in its UL Listing and the manufacturer's written instructions.

B. The minimum voltage rating for fuses is 250V AC for system voltages of 240V AC and below, and 600V AC for systems voltages 600V AC and below.

C. Fuses shall never be applied above their ampere interrupting capacity (AIC).

D. All fuses shall be new, and supplied by the same manufacturer.

2.2 FUSES

A. New installations: Provide the following types, as indicated.

1. Class CC: 600 volt, 1/10 - 30 amp, fast acting or time delay, current limiting, 200,000 AIC.

2. Class RK5: 250 volt or 600 volt as required, 1 - 600 amp, fast acting, current limiting, 200,000 AIC.

3. Class RK-5: 250 volt or 600 volt as required, 1/10 - 600 amp, dual-element time delay, current limiting, 200,000 AIC.

4. Class L: 600 volt, 601 - 6000 amp, time delay, current limiting, 200,000 AIC.

2.3 FUSEBLOCKS

A. Where indicated or required, provide UL Listed fuseblocks for fuses.

B. Fuseblocks shall be specifically designed for the type of fuses intended to be used, and installed per the manufacturer's written instructions.

2.4 SPARE FUSE CABINET

A. Wall mount, heavy gauge steel or aluminum cabinet with full length recessed piano hinged door with locking handle, shelves as required, gray baked enamel finish, and engraved nameplate to read "Spare Fuses." Size cabinet to hold required spare fuses plus at least 50 percent additional.

2.5 ACCEPTABLE MANUFACTURERS

A. Bussmann; Gould Shawmut; Reliance.

PART 3 - EXECUTION

3.1 GENERAL

A. Fuses shall not be installed until equipment is to be energized.

B. Fuses shall be applied within their ratings. Any discrepancies shall be reported to the Engineer.

C. Fuses shall be applied so as to provide selective coordination (i.e., the fuse directly upstream of the fault operates first).

3.2 FUSE APPLICATION

A. Fuse ampacity: If not indicated, the fuse ampacity shall not exceed the maximum rating as allowed by the National Electrical Code and the equipment to be protected manufacturer's installation instructions, whichever is less.

B. Fuse type: If not indicated, use the following as a guideline.

1. Control circuits and control transformers: Use Class CC, time delay.

2. Motor disconnects and starters and transformers: Use Class RK5.

3. Main building and service disconnects: 600 amp and below, use RK1 or RK5; above 600 amp, use Class L.

4. Load centers, panelboards, and switchboards: Use Class RK1.

3.3 SPARE FUSE CABINET

A. Install where indicated or directed, and stock with required spare fuses.

END OF SECTION 262813

SECTION 262816 SAFETY SWITCHES

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Comply with Division 1 - General Requirements, as well as Division 1 High Performance Buildings Requirements, Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Description of Work: Provide safety switches as indicated.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.4 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Safety Switches shall be included in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Safety Switch manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Referenced Standards: Switches shall be UL listed and labeled and shall meet NEMA and NEC requirements.

B. Manufacturer: Use only one of the following manufacturers, General Electric, Siemens/ITE and Square D..

PART 2 - PRODUCTS

2.1 SAFETY SWITCHES

A. General: NEMA heavy-duty, horsepower rated, fully enclosed, fusible or non-fused as indicated, quick-make/quick-break switching mechanism interlocked with cover, and integral handles that accept a minimum of three padlocks.

B. Neutral and Ground: Include insulated solid neutral terminal and/or solid grounding terminal, where circuits include these conductors.

C. Enclosures: NEMA types as specified below or as indicated. Provide NEMA-1 unless indicated otherwise.

D. Ratings:

1. Voltage, phases, amperages and fusing as indicated.

2. In the unfused configuration, switches shall have at least the following short circuit interrupting capacities:

Size	Interrupting Capacity 3 Phase, Symmetrical 600 Volts
30 amp	950
60 amp	1,750
100 amp	1,800
200 amp	3,600
400 amp	10,000
600 amp	15,000
800 amp	20,000
1,200 amp	30,000

3. In the fused configuration, switches shall have an interrupting capacity of at least 100,000 amps symmetrical at six hundred (600) volts when used with Class RK-5 time delay current limiting fuses, and 200,000 amperes symmetrical at 600 volts when used with Class RK-1 current limiting fuses.

4. Switches shall have a withstandability rating expressed in amperes squared times time, times ten raised to the sixth power when tested at 480 volts, 3-phase with 54,066 amps available, 15% power factor and 685 volts first peak recovery voltage as scheduled below:

Size	Withstandability (1^2xtx10^6)
30 amp	0.36
60 amp	0.95
100 amp	1.87
200 amp	5.80
400 amp	19.00
600 amp	47.00
800 amp	92.80
1,200 amp	208.80

E. Guards: Line shield guards to prevent contact with live parts.

F. Contacts: Silver alloy, switch blades shall be de-energized in the open position.

G. Lugs: Solderless type.

2.2 REJECTION FUSE CLIPS

A. Provide for fusible switches (30-600A) to prevent the installation of Class H and Class K non-current-limiting fuses.

2.3 AUXILIARY INTERLOCK KITS

A. Install where indicated or required, for simultaneously controlling separately powered control circuit associated with safety switch load. Control circuit contacts to break contact before and make contact after main safety switch contacts.

2.4 NAMEPLATES

A. Per 260553 - Electrical Identification.

2.5 ACCEPTABLE MANUFACTURERS

A. General Electric; Siemens/ITE and Square D.

PART 3 - EXECUTION

3.1 GENERAL

A. Manufacturer: Use only one manufacturer for all safety switches on the project.

B. Type and Ratings: Provide non-fused safety switches unless specifically noted fused, and ratings as indicated. If ratings are not indicated, provide switch with ratings to suit the system voltage and load served.

C. Enclosure Type: Provide NEMA-1 unless indicated otherwise. Provide NEMA-3R enclosures in exterior or damp locations, NEMA-4 enclosures in wet locations, and other enclosure types as indicated, or required to suit the application.

D. Mounting: Mount safety switches where indicated, and on wall or column adjacent to unit served, or directly to unit or supporting framework, where applicable.

END OF SECTION 262816

SECTION 262900 MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Description of Work: Provide motor controllers as indicated on the drawings and specified herein. Coordinate with Division 23 on motors needing controllers.

C. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5

a. The above HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Shop Drawings: Submit the following in accordance with Conditions of Contract and Division 1.

1. Product Data: For each controller provide a separate manufacturers data sheet with the following:

a. Controller identification as called out in the Contract Documents.

b. Controller information to include the ratings, dimensions, options and features.

c. Motor load current and overload relay rating list: complied and submitted after acceptance testing demonstrating and overload relay selection.

2. Wiring Diagram: For each control provide wiring and control logic diagrams.

C. Certified Reports: Indicating the testing and observations requested herein.

D. Operations/Maintenance Data: Complete operation and maintenance data for inclusion into the Operations and Maintenance Manual to include all shop drawings, test reports, and maintenance and repair manuals.

E. Field Test Organization Certification: Signed by the Contractor certifying the organization is in accordance with the requirements specified herein. Include a list of completed projects, owners names, addresses and telephone numbers along with the individual who performed the test.

F. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.4 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Motor Controllers to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Motor Controllers manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide motor controllers and related equipment from manufacturers regularly engaged in the manufacture of equipment of the types and capacities indicated, with such products in satisfactory use in similar service for not less than 5 years. Manufacturer must also maintain, within 100 miles of the project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Components and Installation: NFPA 70 "National Electrical Code" (NEC).

C. Listing and Labeling: Provide MCs that are listed and labeled.

1. The terms "listed" and "labeled:" As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

D. NEMA Compliance: NEMA ICS 2, "Industrial Control Devices, Controllers and Assemblies."

E. UL Compliance: UL 508, "Electric Industrial Control Equipment."

F. Single-Source Responsibility: Obtain similar motor-control devices from a single manufacturer.

G. Field-Testing Organization Qualifications: To qualify for acceptance, a testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct satisfactorily the testing indicated.

1.7 COORDINATION

A. General: Coordinate features of controllers and control devices with pilot devices and control circuits provided under other Sections covering control systems.

1.8 EXTRA MATERIALS

A. Spare Fuses and Indicating Lamps: Furnish one spare for every 5 installed units, but not less than one set of 3 of each kind.

B. Motor Overload Relays: Provide a minimum of three of each type for each controller in a sealable package with the intended use clearly marked.

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturers' subject to compliance with these specifications provide products from the following manufacturers:

1. General Electric.
2. Allen Bradley.
3. Siemens.

B. General: Coordinate the features of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, the duty cycle of the motor, drive, and load, and the pilot device, and control circuit affecting controller functions. Provide controllers that are horsepower rated to suit the motor controlled.

C. Size: NEMA rated based on horsepower or larger as indicated. IEC rated unacceptable.

D. Contacts shall open each ungrounded connection to the motor.

E. Overload Relays: Ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of the specific motor to which connected with appropriate adjustment for duty cycle. Overload relays are not to be ordered until after inspecting the motor nameplate on the job site.

F. Enclosures: For individually mounted motor controllers and control devices, comply with NEMA Standard 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)." Provide enclosures suitable for the environmental conditions at the controller location. Provide NEMA Type 1 enclosures for indoor and NEMA 4 for outdoor except as otherwise indicated.

2.2 MANUAL MOTOR CONTROLLERS

A. Description: Quick-make, quick-break toggle action, with pilot light, lockable in the off position.

2.3 MAGNETIC MOTOR CONTROLLERS

A. Description: Provide full-voltage, nonreversing, across-the-line, magnetic controller.

B. Control Circuit:

1. Control Power: Provide 120 V control power transformer integral with controller where no separate 120V control power to controller is indicated. Provide control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity. Transformer shall be connected to the load side of the motor's disconnect switch.

2. Overcurrent Protection:

a. With Transformer: Provide fuses on both primary legs and one secondary leg. Sizes to be sized based on manufacturer's requirements. In no case may the fuse size exceed the maximum size allowed by the NEC.

b. Without Transformer: Provide fuses on each ungrounded leg sized based on manufacturer's requirements. In no case may the fuse size exceed the maximum size allowed by the NEC.

C. Combination Controllers: Switch type, fused or non-fused as indicated; quick-make, quick-break switch, factory assembled with controller and arranged to disconnect it. Unit shall be designed for full voltage, across the line startings non-reversing; and lockable in the off position. For faced switches, provide rejection-type fuse clips and fuses as indicated. Provide defeatable interlock for switch and controller door.

D. Combination Controllers: Circuit breaker type, with adjustable trip circuit breaker, designed and listed for motor starting. Unit to be factory assembled, with circuit breaker arranged to disconnect the controller, and lockable in the off position. Unit shall be designed for full voltage, across the line starting, non-reversing.

E. Enhanced-Protection Overload Relay: Provide overload relays with NEMA Class 10 tripping characteristics where indicated. Select to protect motor against voltage unbalance and single phasing.

2.4 MULTISPEED MOTOR CONTROLLERS

A. General: Match controller to motor type, application, and to number of speeds. Conform to Article "Magnetic Motor Controllers" above. Provide auxiliary devices as indicated. Provide all required relays factory installed in controller enclosure.

B. Controller for Consequent Pole Motor: Provide number of poles to suit motor speeds indicated. Select controller to suit motor type indicated.

C. Controller for Separate Winding Motor: Provide number of contactors to suit motor speeds indicated. Select controller to suit motor type indicated.

D. Compelling Relay: Arrange to assure motor will start only at low speed.

E. Accelerating Relay: Provide for selection of ultimate motor speed by pushbutton or pilot device as indicated with automatic timed acceleration through any speeds lower than that selected.

F. Decelerating Relay: Provide selection of lower than current operating speed by pushbutton or pilot device as indicated with deceleration automatically timed through any intervening speeds.

2.5 REDUCED-VOLTAGE MOTOR CONTROLLERS

A. Star-Delta Magnetic Type: Closed transition with adjustable time delay.

B. Part Winding Magnetic Type: Closed transition with separate overload relays for starting and running sequences.

C. Autotransformer Magnetic Type: Closed transition.

D. Solid-State Type: Suitable for use with standard NEMA Design B, 3-phase induction motors, providing adjustable acceleration rate control using voltage or current ramp. Provide adjustable starting torque control with up to 500 percent current limitation for 20 seconds. Provide surge suppressor in solid-state power circuits to provide 3-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage. Provide snubbers to prevent malfunction due to system voltage transients. Provide overload protection for NEMA Class 10 or better. Provide LEDs to indicate motor and control status including control power available, controller on, overload trip, loss of phase, and shorted SCR.

1. Provide automatic voltage reduction controls to reduce voltage when motor is running at light load.

2. Provide a motor running contactor to operate automatically when full voltage is applied to motor. Controller shall operate as a magnetic motor controller except during starting of motor.

2.6 SOLID-STATE, VARIABLE FREQUENCY CONTROLLERS

A. General: Provide controllers listed and labeled as a complete unit and arranged to provide variable speed of a standard NEMA Design B, 3-phase, induction motor by adjusting output voltage and frequency of controller. Controller shall be designed and rated by the manufacturer for the type of load (e.g., fans, blowers, and pumps) with which used. Controller shall also be approved by the manufacturer for the type of connection used between the motor and load (direct connection or power transmission connection).

B. Isolation Transformer: 1-to-1 ratio, with capacity coordinated by the manufacturer for the controller, motor, drive, and load combination.

C. Ratings: As follows:

1. Output Rating: 3-phase, 6 to 60 Hz, with voltage proportional to frequency throughout the voltage range.

2. Output Rating: 3-phase, 6 to 66 Hz, with torque constant as speed changes.

3. Output Rating: 3-phase, 6 to 120 Hz, with horsepower constant throughout the speed range.

4. Starting Torque: 100 percent of rated torque, or as indicated.

5. Speed Regulation: Plus or minus 1 percent.

6. Ambient Temperature: 0□C to 40□C.

7. Efficiency: 95 percent minimum at full load, 60 Hz.

8. Power Factor: Minimum .95 constant at all speeds.

D. Isolated control interface to allow the controller to follow one of the following over an 11:1 speed range:

1. Electrical Signal: 4 to 20 milliamperes at 24V.
2. Electrical Signal: 0-5VDC.
3. Pneumatic Signal: 3 to 15 psig.

E. Internal Adjustability: Provide the following internal adjustment capabilities:

1. Minimum Speed: 5 to 25 percent of maximum RPM.
2. Maximum Speed: 80 to 100 percent of maximum RPM.
3. Acceleration: 2 to 22 seconds.
4. Deceleration: 2 to 22 seconds.
5. Current Limit: 50 to 110 percent of maximum rating.

F. Multiple Motor Capability: Controller suitable for service to multiple motors, and furnished with a separate overload relay and protection for each individual motor. Tripping of any overload relay shall shut off the controller and all motors served by it.

G. Self-protection and reliability features shall include:

1. Input transient protection by means of surge suppressors.

2. Snubber networks to protect against malfunction due to system voltage transients.

3. Motor Overload Relay: Adjustable and capable of NEMA class 10 performance.

4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.

5. Instantaneous Overcurrent Trip.

6. Loss of Phase Protection.

7. Reverse Phase Protection.

8. Under- and Over-Voltage Trips.

9. Over temperature Trip.

10. Short Circuit Protection.

H. Automatic Reset/Restart: Attempt 3 restarts after controller fault or on return of power to the system following an interruption and before shutting down for manual reset or fault correction. Provide for restarting during deceleration without damage to the controller, motor, or load.

I. Power Interruption Protection: Prevent motor reenergizing after a power interruption until motor has stopped.

J. Operation and maintenance features shall include:

1. Status Lights: Door-mounted LED indicators to indicate power on, run, overvoltage, line fault, overcurrent, and external fault.

2. Elapsed Time Meter.

3. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer.

4. Current-Voltage-Frequency Indicating Devices: Mount meters or digital readout device and selector switch flush in controller door and connect to indicate controller output.

5. Manual Bypass: Magnetic contactor arranged to safely transfer the motor from the controller to the power line, or from the line to the controller while the motor is at zero speed. Include Controller-Off-Bypass selector switch and indicator lights to indicate mode selection.

6. Integral Main Disconnect: Circuit breaker connected to shut down all power to both the controller and the bypass. Interlock breaker with cabinet door.

7. Auxiliary Motor Contactors: Electrically interlocked. One contactor connected between the controller output and the motor, controlled by the controller regulator; and one between the bypass power line and the motor, providing across-the-line starting capability in the bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.

8. Isolating Circuit Breaker: Arranged to electrically isolate the variable-speed controller to permit safe trouble-shooting and testing of the controller, both energized and de-energized, while the motor is operating in the bypass mode.

9. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

10. Capability to read Energy Usage and transmit to building control system. Coordinate with controls contractor.

2.7 CONTROL DEVICES

A. General: Oil tight type, single hole mounting. Factory installed in controller enclosure except as otherwise indicated. Where separately mounted, provide NEMA 1 enclosure except as otherwise indicated.

B. Pilot Lights: Heavy duty LED type with pilot light colors green for motor running, and other colors as indicated.

C. Pushbutton Stations: Heavy duty type. Labeled “Start” button, red button labeled “Stop,” and other designations as indicated.

D. Selector Switches: Heavy duty type. Maintained position type, two position “On-Off” and three position “Hand-Off-Auto” when in a circuit with an automatic device, and other selector switches as indicated.

E. Minimum Requirements: For each magnetic starter, provide at least a “Run” pilot light and an “H-O-A” selector switch unless indicated otherwise. Provide alternate and/or additional control devices as indicated.

F. Remote Control Devices: Provide remote mounted control devices as indicated.

G. Control Relays: Heavy duty industrial grade, with number and type of contacts indicated, and 120 volt coil.

H. Elapsed Time Meter: Heavy duty with digital readout in hours.

PART 3 - EXECUTION

3.1 APPLICATION

A. Pushbutton Stations: Except as otherwise indicated, momentary-contact, start-stop units. Provide in covers of magnetic controllers for manually started motors where indicated, and connect start contact in parallel with sealing auxiliary contact for low-voltage protection.

B. Hand-Off-Automatic Selector Switches: Except as otherwise indicated, install in covers of manual and magnetic controllers of motors started and stopped by automatic controls or interlocks with other equipment. Make control connections so only the manual and automatic control devices that have no safety functions will be bypassed when the switch is in the hand position. Connect motor-control circuit in both hand and automatic positions for safety type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors. Make control-circuit connections to a hand-off-automatic switch or to more than one automatic control device in accordance with an indicated wiring diagram or one that is manufacturer approved.

3.2 INSTALLATION

A. General: Install motor control devices in accordance with manufacturer's written instructions.

B. Manufacturer's Field Services: Arrange and pay for the services of a factory-authorized service representative to inspect the field assembly and connection of components, and supervise the pretesting and adjustment of solid-state controllers.

C. Location: Locate controllers as indicated and within sight of motors controlled.

D. Mounting: For control equipment at walls, bolt units to wall or mount on light-weight structural steel channels bolted to the wall. For controllers not at walls, provide freestanding racks fabricated of structural steel members and light-weight slotted structural steel channels. Use feet consisting of 3/8-inch thick steel plates, 6 inches square, bolted to the floor. Use feet for welded attachment of 1-1/2-inch by 1-1/2-inch by 1/4-inch vertical angle posts not over three feet on centers. Connect the posts with horizontal lightweight slotted steel channels and bolt the control equipment to the channels.

E. Motor-Controller Fuses: Conform to requirements of Division 26 Section "Fuses."

3.3 IDENTIFICATION

A. Identify motor control components and control wiring in accordance with Division 26 Section "Electrical Identification."

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between motor control devices and control/indicating devices as specified in Division 16 Section "Motor Power and Control Wiring" for hard-wired connections.

B. Install wiring in enclosures neatly bundled, trained, and supported.

3.5 CONNECTIONS

A. Tighten connectors, terminals, bus joints, and mountings. Tighten field connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, comply with tightening torques specified in UL 486A and UL 486B.

3.6 FIELD QUALITY CONTROL

A. Independent Testing Organization: Arrange and pay for the services of an independent electrical testing organization to perform tests and observations on motor control devices.

B. Reports: Prepare written reports certified by testing organization of tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include records of repairs and adjustments made.

C. Labeling: On satisfactory completion of tests and related effort, apply a label to tested components indicating test results, date, and responsible organization and person.

D. Schedule visual and mechanical inspections and electrical tests with at least one week's advance notification.

E. Pretesting: On completing installation of the system, perform the following preparations for tests:

1. Make insulation resistance tests of conducting parts of motor control components; and of connecting supply, feeder, and control circuits. For devices containing solid-state components, use test equipment and methods recommended by the manufacturer.

2. Make continuity tests of circuits.

3. Provide set of Contract Documents to test personnel. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.

4. Provide manufacturer's instructions for installation and testing of motor control devices to test personnel.

F. Visual and mechanical inspection: Include the following inspections and related work.

1. Motor-Control Device Ratings and Settings: Verify that ratings and settings as installed are appropriate for final loads and final system arrangement and parameters. Recommend final protective-device ratings and settings where differences are found. Use accepted revised ratings or settings to make the final system adjustments. Prepare and submit the load current and overload relay heater list.

2. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current project drawings.

3. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instructions.

4. Check tightness of electrical connections of devices with calibrated torque wrench. Use manufacturer's recommended torque values.

5. Clean devices using manufacturer's approved methods and materials.

6. Verify proper fuse types and ratings in fusible devices.

G. Electrical Tests: Perform the following in accordance with manufacturer's instructions:

1. Insulation resistance test of motor control devices conducting parts to the extent permitted by the manufacturer's instructions. Insulation resistance less than 100 megohms is not acceptable.

2. Use primary current injection to check performance characteristics of motor-circuit protectors and for overload relays of controllers for motors 15 horsepower and larger. Trip characteristics not within manufacturer's published time-current tolerances are not acceptable.

3. Make adjustments for final settings of adjustable-trip devices.

4. Test auxiliary protective features such as loss of phase, phase unbalance and undervoltage to verify operation.

5. Check for improper voltages at terminals in controllers that have external control wiring when controller disconnect is opened. Any voltage over 30V is unacceptable.

H. Correct deficiencies and retest motor control devices. Verify by the system tests that specified requirements are met.

3.7 CLEANING

A. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally using methods and materials as recommended by manufacturer.

3.8 DEMONSTRATION

A. Training: Arrange and pay for the services of a factory-authorized service representative to demonstrate solid-state and variable-speed controllers and train Owner's maintenance personnel.

B. Conduct a minimum of 4 hours of training in operation and maintenance as specified under "Instructions to Owner's Employees" in Division 1 Section "Project Closeout." Include training relating to equipment operation and maintenance procedures.

C. Schedule training with at least seven days' advance notification.

END OF SECTION 262900

SECTION 263213 (OPS) - ENGINE GENERATORS – WWTP (OFF-SITE PUMP STATION NO. 2)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. This Section includes packaged engine-generator sets for standby power supply with the following features:

1. Diesel engine.
2. Unit-mounted control and monitoring.
3. Weatherproof enclosure.

B. Related Sections include the following:

1. Division 26 Section "Service Entrance Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816, Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS

B. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.
2. Time-current characteristic curves for generator protective device.

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
4. Wiring Diagrams: Power, signal, and control wiring.

D. Manufacturer Seismic Qualification Certification: Submit certification that day tank**,** engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

   b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Qualification Data: For manufacturer.

F. Source quality-control test reports.

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
5. Report of sound generation.
6. Report of exhaust emissions showing compliance with applicable regulations.
7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

   1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with ASME B15.1.

F. Comply with NFPA 37.

G. Comply with NFPA 70.

H. Comply with NFPA 99.

I. Comply with NFPA 110 requirements for Level 1 emergency power supply system.

J. Comply with UL 2200.

K. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

L. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.6 PROJECT CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

   1. Ambient Temperature: Minus 15 to plus 40 deg C.
   2. Relative Humidity: 0 to 95 percent.
   3. Altitude: Sea level to 1000 feet (300 m).

1.7 COORDINATION

A. Coordinate size and location of structural supports and concrete encasement for supports for package engine generators. Concrete, reinforcement, and formwork requirements are as shown on the plans.

1.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Onan/Cummins Power Generation; Industrial Business Group.
2. Caterpillar; Engine Div.
3. Kohler Co.; Generator Division.

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

C. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated**,** with capacity as required to operate as a unit as evidenced by records of prototype testing.
2. Output Connections: Three-phase, four wire.

3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 5 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: .25 percent of rated frequency from no load to full load.
4. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
5. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

A. Fuel: Diesel.

B. Size: 150 KW

C. Rated Engine Speed: 1800 rpm.

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Engine Fuel System:

1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

G. Governor: Adjustable isochronous, with speed sensing.

H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

    a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge after installation is complete shall be 85 dBA or less.

J. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

K. Starting System: 24-V electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: 60 seconds.
4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least twice without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.
7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:

    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery

terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.

c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.

d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.

e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.

f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

A. Comply with NFPA 30.

B. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:

1. Tank level indicator.
2. Capacity: Fuel 300 gallons.
3. Vandal-resistant fill cap.
4. Containment Provisions: Comply with requirements of authorities having jurisdiction.
5. The Contractor shall provide a full tank of fuel when all testing is completed and equipment is turned over to the Owner.

2.5 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

B. Configuration: Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers. Panel features shall include the following:

C. Indicating and Protective Devices and Controls:

1. AC voltmeter.

2. AC ammeter.
3. AC frequency meter.
4. DC voltmeter (alternator battery charging).
5. Engine-coolant temperature gage.
6. Engine lubricating-oil pressure gage.
7. Running-time meter.
8. Ammeter-voltmeter, phase-selector switch(es).
9. Generator-voltage adjusting rheostat.
10. Start-stop switch.
11. Overspeed shutdown device.
12. Coolant high-temperature shutdown device.
13. Coolant low-level shutdown device.
14. Oil low-pressure shutdown device.
15. Fuel tank derangement alarm.
16. Fuel tank high-level shutdown of fuel supply alarm.
17. Generator overload.
18. Emergency stop.
19. Kw meter.
20. Low coolant temperature alarm.
21. Failure to crank.
22. Battery low.

D. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

E. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.

1. Engine high-temperature shutdown.
2. Lube-oil, low-pressure shutdown.
3. Overspeed shutdown.
4. Remote emergency-stop shutdown.
5. Engine high-temperature prealarm.
6. Lube-oil, low-pressure prealarm.
7. Fuel tank, low-fuel level.
8. Low coolant level.
9. Remote audio and visual alarms.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.

1. Tripping Characteristic: Designed specifically for generator protection.
2. Trip Rating: Matched to generator rating.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

B. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:

1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Dripproof.

G. Instrument Transformers: Mounted within generator enclosure.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.

1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

K. Subtransient Reactance: 12 percent, maximum.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

B. Provide Generator Housing as specified:

1. Weatherproof and south attenuated.
2. Internally mounted muffler.
3. Sound insulating panels – Level 1.
4. Fourteen gauge steel panels.
5. Twelve gauge steel posts.
6. Removable panels and doors.
7. Corrosion resistant.
8. Chambered roof.
9. Lockable doors.
10. UL complaint.

2.9 FINISHES

A. Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.10 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Full load run.
3. Maximum power.
4. Voltage regulation.
5. Transient and steady-state governing.
6. Single-step load pickup.
7. Safety shutdown.
8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with elastomeric isolator pads having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases. Concrete base construction is specified on drawings.

D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

A. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

A. Identify system components according to Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection (except those indicated to be optional) for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters:
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

    a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    c. Verify acceptance of charge for each element of the battery after discharge.
    d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
7. Exhaust Emissions Test: Comply with applicable government test criteria.
8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line for measurement, and compare measured levels with required values.

D. Coordinate tests with tests for transfer switches and run them concurrently.

E. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

F. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

G. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

H. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

I. Remove and replace malfunctioning units and retest as specified above.

J. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

K. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 263213 (OPS)

SECTION 263213 ENGINE GENERATOR SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Description of Work: Provide engine generator system(s) including engine, generator set, cooling system, fuel system, combustion air intake and engine exhaust systems, starting system, and the additional features as indicated.

C. Related Sections: All Division 26 sections are applicable to this section.

1. Division 01, High Performance Buildings Requirements Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 SYSTEM DESCRIPTION

A. This section includes packaged engine-generator sets for standby power supply with the following features:

1. Diesel engine
2. Unit-mounted cooling system.
3. Unit-mounted controls and monitoring.
4. Performance requirements for sensitive loads
5. Outdoor enclosure

B. System Includes: Engine coupled to an a.c. generator unit with specified and necessary components. Engine generator and components are factory-mounted and -aligned on a structural steel skid. Subsystems and auxiliary components and equipment are as indicated.

C. Functional Description: When the mode selector switch on the control and monitoring panel is in the “automatic” position, remote control contacts in one or more separate automatic transfer switches initiate the starting and stopping of the generator set. When the mode selector switch is placed in the “on” position, the generator set starts manually. The “off” position of the same switch initiates shutdown of the generator set. When the unit is running, specified system or equipment failures or derangements automatically shut the unit down and initiate alarms. Operation of a remote emergency stop switch also shuts down the unit. Automatic transfer switches are specified in another Section of these Specifications.

D. Functional Description: Switching an “on-off” switch on the generator control panel to the “on” position starts the generator set. The “off” position of the same switch initiates shutdown of the unit. When the unit is running, specified system or equipment failures or derangements automatically shut down the unit and initiate alarms. Operation of a remote emergency stop switch also shuts down the unit.

1.4 SYSTEM SERVICE CONDITIONS

A. Environmental Conditions: Engine generator system withstands the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: Minus 15ºC to plus 40ºC.
2. Relative Humidity: 0 to 95 percent.
3. Altitude: Sea level to 1000 feet (300 m).

B. Unusual Service Conditions: Engine generator system operates in the following conditions:

1.5 SYSTEM PERFORMANCE

A. General: Engine generator system shall perform as specified herein while providing power to the loads indicated in the contract documents.

B. Steady-State Voltage Operational Bandwidth: 2 percent of rated output voltage from no load to full load.

C. Steady-State Voltage Modulation: Less than 1 Hz.

D. Transient Voltage Performance: Not more than 10 percent variation for 100 percent step-load increase or decrease at .8 power factor. Voltage recovers to remain within the steady-state operating band within 2 seconds.

E. Maximum Initial Voltage Dip: 20 percent.

F. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.

G. Steady-State Frequency Stability: When the system is operating at any constant load within the rated load, there are no random speed variations outside the steady-state operational band and no regular or cyclical hunting or surging of speed.

H. Transient Frequency Performance: Less than 3 Hz variation for a 50 percent step-load increase or decrease. Frequency recovers to remain within the steady-state operating band within 3 seconds.

I. Output Waveform: At no load, the harmonic content measured line-to-line or line-to-neutral does not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor determined according to NEMA MG1, “Motors and Generators,” does not exceed 50.

J. Sustained Short-Circuit Current: For a 3-phase bolted short circuit at the system output terminals, the system will supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to any generator system component.

K. Temperature Rise of Generator: Within acceptable limits for insulation systems used according to NEMA MG1 when operating continuously at standby rating conditions, including 2 hours per 24 hours at 110 percent of rated capacity.

L. Generator-Set Performance for Sensitive Loads

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance

a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed

2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load

3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.

4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.

5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.

7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.

8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.

9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

M. Starting Time: Maximum total time period for a cold start under full load, with ambient temperature at the low end of the specified range, is 10 seconds. Time period includes output voltage and frequency settlement within specified steady-state bands.

N. Resistance to Seismic Forces: Internal and external supports for components, supports, and fastenings for batteries, wiring, and piping are designed to withstand static or anticipated seismic forces, or both, in any direction. For each item, use a minimum force value equal to the weight of the item.

1.6 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product data for products specified in this Section. Include data on features, components, ratings, and performance. Include dimensioned outline plan and elevation drawings of engine generator set and other system components. In attrition included the following:

1. Thermal damage curve for generator
2. Time-current characteristic curves for generator protective device.

C. Maintenance data for system and components for inclusion in Operating and Maintenance Manual specified in Division 1. Include the following:

1. Lists: Tools, test equipment, spare parts, and replacement items recommended to be stored at the site for ready access. Include part and drawing numbers, current unit prices, and source of supply.

2. Detailed Operating Instructions: Cover operation under both normal and abnormal conditions.

D. Qualification Data for Manufacturer: Include capabilities and experience data required to demonstrate qualifications specified in Quality Assurance Article. Include list of completed projects with project names and addresses and names of Engineers and Owners, plus other information specified.

E. Conformance Certification: Manufacturer shall submit signed certification, the equipment being supplied meets all the requirements of the contract documents.

F. Independent Field-Testing Organization Certificates: Signed by Contractor, certifying that the organization complies with the requirements specified in Quality Assurance below.

G. Certified Summary of Prototype Unit Test Report: Submit certified copies of actual prototype unit test report to include all values and adjustments used and identify engine generator by its manufacturers' serial number. Report shall demonstrate the unit's ability to provide the indicated outputs. See Quality Assurance for test requirements.

H. Certified Test Reports of Components and Accessories: Submit for devices that are equivalent, but not identical, to those tested on prototype unit.

I. Exhaust Emissions Test Report.

J. Certification of Torsional Vibration Compatibility: Conform to NFPA 110.

K. Factory Test Reports: Prior to shipment submit 3 copies. For units to be shipped for this Project showing evidence of compliance with specified performance and output requirements.

L. Field Test Report: Record of tests specified in Part 3.

M. Shop Drawings: Detail fabrication, piping, wiring, and installation of the field-installed portions of the system. Include general arrangement drawings showing locations of auxiliary components in relation to the engine generator set and duct, piping, and wiring connections between the generator set and the auxiliary equipment. Show connections, mounting, and support provisions and access and working space requirements. The following is a minimum list required and shall be logically organized in an 8-1/2" x 11" format in a binder with a table of contents.

1. Itemized list of engine generator set and all standard and optional accessories, and auxiliary equipment to be provided.

2. Manufacturer's standard catalog sheets for engine generator set.

3. Dimensioned outline drawings of complete engine generator set locating all connections and indicating weights.

4. Engine Specifications with complete listing of accessories.

5. Certified horsepower and fuel rate curves at specified rating. Including engine sizing calculation.

6. Complete description of vibration damping mounts.

7. Alternator (generator) specifications including voltage regulator and exciter specifications.

8. Detailed drawing of terminal compartment and method of connection.

9. Detailed drawing of control panel identifying all devices and features.

10. Complete schematic diagrams of all wiring for all indicator, control, auxiliary and alarm systems, identifying each item by part number and function.

11. Battery and battery charger specifications.

12. Detailed description of all fuel system components and accessories.

13. Detailed description of all exhaust system components and accessories.

14. Detailed description of all miscellaneous auxiliary equipment.

15. Wiring Diagrams for System: Show power and control connections and distinguish between factory-installed and field-installed wiring.

N. Operation and Maintenance Data: Three bound manuals including complete shop drawings and test reports, preventative maintenance instructions, complete parts lists, wiring diagrams including a composite diagram of the complete installation, fuel specifications, lubricating oil and grease specifications, literature describing the function of the unit and each piece of accessory equipment, and a shop manual describing engine and generator repair.

O. Maintenance Materials: Provide maintenance kit in wall hung cabinet near location of engine generator set (or where directed) including one replacement fan bet for each type used on each engine, a hydrometer with a scale divided in two point increments suitable for batteries used on project, an ear protection headset, and all special-design tools necessary for routine maintenance and minor repairs.

1.7 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Engine Generator Systems to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Engine Generator manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of the types and capacities indicated that is able to show evidence of continuous engagement in the manufacturer of engine generator sets manufacture for at least the last 5 years.

1. Emergency Service: Supplying manufacturer maintains a service center capable of providing training, parts, and emergency maintenance and repairs at the Project site with 4 hours maximum response time.

2. Responsibility: Supplying manufacturer and associated service center accept full responsibility for all the quality and performance of all components.

B. Independent Field-Testing Organization Qualifications: To qualify for acceptance, an independent testing organization must demonstrate, based on evaluation of organization-submitted criteria

conforming to ASTM E 699, that it has the experience and capability to conduct the indicated testing satisfactorily.

C. Comply with applicable EGSMA, IEEE, NSMA and UL Standards Code.

D. Comply with ASME B15.1.

E. Comply with NFPA 70.

F. Comply with UL2200.

G. Comply with NFPA 37, "Stationary Combustion Engines and Gas Turbines."

H. Safety Standard: Comply with ASME 15.1 "Safety Standard for Mechanical Power Transmission Apparatus."

I. Comply with NFPA 110, "Standard for Emergency and Standby Power Systems," for requirements for a Level 2 emergency power supply system.

J. NRTL Listing: System components of types and ratings for which NRTL listing or labeling service is established and components are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

K. Engine Exhaust Emissions: Comply with applicable Federal, State, and local government requirements.

L. Single-Source Responsibility: Obtain engine generator system components from a single manufacturer with responsibility for entire system. Unit shall be a representative product built from components that have proven compatibility and reliability and are coordinated to operate as a unit as evidenced by records of prototype testing.

M. Source Quality Control:

1. Factory Tests: Include prototype testing and Project-specific equipment test (equipment manufactured specifically for this Project).

2. Project-Specific Equipment Tests: Test engine generator set and other system components and accessories prior to shipment. Test items individually and assembled and connected as a complete system at the factory in a manner equivalent to that required at the Project site. Record and report test data. Conform to SAE 8528, "Engine Power Test Code-Spark Ignition and Diesel," and the following:

a. Test Equipment: Use instruments calibrated within the previous 12 months and with accuracy directly traceable to the National Institute of Standards and Technology (NIST).

b. Hydrostatic Test: Perform on radiator, heat exchanger, and engine water jacket.

c. Generator Tests: Conform to IEEE 115, "Test Procedures for Synchronous Machines."

d. Complete System Continuous Operation Test: Includes nonstop operation for a minimum of 8 hours, including at least 1 hour each at 1/2, 3/4, and full load, and 2 hours at 110 percent of full load. If unit stops during the 8-hour test, repeat the complete test. Record the following minimum data at the start and end of each load run, at 15-minimum intervals between those times, and at 15-minute intervals during the balance of the test:

1.) Fuel consumption.
2.) Exhaust temperature.
3.) Jacket water temperature.
4.) Lubricating oil temperature and pressure.
5.) Generator load current and voltage, each phase.
6.) Generator system gross and net output kW.

e. Complete System Performance Tests: Include the following to demonstrate conformance to specified performance requirements:

1.) Single-step load pickup.
2.) Transient and steady-state governing.
3.) Transient and steady-state voltage performance.
4.) Safety shutdown devices.

f. Compliance: Correct all equipment/systems which caused tests parameters to be outside of specified limits prior to shipment.

g. Observation of Test: Provide 2-week advance notice of tests and opportunity for observation of test by Owner's representatives.

1.10 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver engine generator set and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

1.12 GUARANTEE

A. Provide certification from the engine generator set manufacturer that the final installation is proper and in no way voids any equipment warranty.

B. Manufacturer's Warranty: Including all parts and labor to replace defective materials and workmanship for a period of five years or 1500 hours of engine running time, whichever is sooner.

C. Provide certification from the generator set supplier that the engine generator system (with weatherproof housing and associated accessories), if properly maintained, will dependably start and operate under all weather conditions at the installation site.

1.13 EXTRA MATERIALS

A. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents. Deliver extra materials to the Owner.

1. Fuses: 1 for every 10 of each type and rating, but not less than 1 of each.
2. Pilot Lights: 2 for every 6 of each type used, but not less than 2 of each.
3. Filters: 1 set each of lubricating oil, fuel, and combustion air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Caterpillar, Inc.
2. Generac Power Systems Inc.
3. Kohler Co.

2.2 ENGINE GENERATOR SET

A. Power Output Rating: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.

B. Skid: Adequate strength and rigidity to maintain alignment of the mounted components without dependence on a concrete foundation. Skid is free from sharp edges and corners. Lifting attachments are arranged to facilitate lifting with slings without damaging any components.

C. Overall Dimensions: Verify engine generator set shall fit in the space provided.

D. Rigging Diagram: Inscribed on a metal plate permanently attached to the skid. Diagram indicates location and lifting capacity of each lifting attachment and location of the center of gravity.

2.3 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Minimum Size/Rating: 3000kW, 480/277 volt, 3-phase, 4-wire.

1. Wound field brushless excited.
2. Permanent magnet excited.

B. Comply with NEMA MG 1, “Motors and Generators,” and specified performance requirements.

C. Drive: Generator shaft is directly connected to the engine shaft. Exciter is rotated integrally with generator rotor.

D. Temperature Rise: 75ºC.

E. Station Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

F. Construction prevents mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

G. Excitation uses no-slip or collector rings, or brushes, and is arranged to sustain generator output under short circuit conditions as specified.

H. Enclosure: Dripproof.

I. Instrument Transformers: Mounted within generator enclosure.

J. Voltage Regulator: Solid-state-type, separate from exciter, providing performance as specified.

1. Adjusting rheostat on control and monitoring panel provides plus or minus 5 percent adjustment of output voltage operating band.

K. Surge Protection: Conform to UL 1449, "Transient Voltage Surge Suppressors." Mount suppressors in generator enclosure and connect to load terminals.

L. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above the dew point.

2.4 ENGINE

A. Type: 4 cycle, minimum 4 cylinder, directly coupled to generator.

B. Operating Speed: Engine - 1800 rpm. Piston speed for 2-cycle engines - 1725 feet per minute. Piston speed for 4 cycle - 2250 feet per minute.

C. Minimum Engine Size: Shall be based on minimum brake horsepower output required from engine calculated as follows. If calculation results in a non standard size engine select the next size larger.

$$BHP = \frac{\text{Generator kW Rating}}{\text{Generator efficiency} \times .746} + \text{Demand of ancillary engine driven equipment}$$

D. Lubrication System: Pressurized by a positive displacement pump driven from the engine crankshaft. The following items are mounted on the engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 microns and smaller while passing full flow.

2. Oil Cooler: Maintains lubricating oil at the manufacturer's recommended optimum temperature throughout 2 hours of operation of the generator set at 110 percent of system power output rating.

3. Thermostatic Control Valve: Controls flow in the system to maintain optimum oil temperature. Unit is capable of full flow and is designed to be fail-safe.

4. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without the use of pumps or siphons or special tools or appliances.

5. Level Measurement: Provide dipstick oil level indicator.

E. Diesel Fuel System:

1. Engine Fuel System: Comply with NFPA 30, "Flammable and Combustible Liquids."

2. Type: _No. 2 diesel.

3. Integral Injection Pumps: Driven by the engine camshaft. Pumps are adjustable for timing and cylinder pressure balancing.

4. Main Fuel Pump: Mounted on the engine. Pump ensures adequate primary fuel flow under starting and load conditions.

5. Parallel Fuel Oil Filters: Ahead of the injection pumps. Changeover valves allow independent use of either filter.

6. Relief/Bypass Valve: Automatically regulates pressure in the fuel line and returns excess fuel to the source.

F. Fuel Piping and Manual Shut-off Valve: As specified in Division 22.

G. Speed Governor: Adjustable electronic isochronous type, with speed sensing.

2.5 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector shall perform the following functions:

1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.

2. Under single or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.

3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.

4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

B. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications

2.6 ENGINE COOLING SYSTEM

A. Description: Closed-loop, liquid-cooled, with radiator factory-mounted on engine generator set skid and integral engine-driven coolant pumping capable of operating in the ranges set under “Environmental Conditions.”

B. Description: Closed-loop, liquid-cooled, with remote radiator and integral engine-driven coolant pumping capable of operating in the ranges set under Environmental Conditions.

C. Engine Jacket Heater:

1. Type: Electric immersion factory installed in jacket coolant system.

2. Rating: Size as recommended by manufacturer for non-derated operation within the temperature ranges specified under “Environment Conditions.”

3. Control: Thermostat.

D. Radiator: Factory-piped and -rated for specified coolant.

E. Coolant: Solution of 50 percent ethylene glycol with coolant conditioner and 50 percent water.

F. Expansion Tank: Constructed of welded steel plate and equipped with gage glass and petcock. Capacity is as indicated.

G. Temperature Control: Self-contained thermostatic control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by the engine manufacturer. Features include:

1. Thermostatic Elements: Interchangeable and nonadjustable.
2. Actuator Design: Normally-open valves to return to open position when actuator fails.

H. Coolant Hose: Flexible assembly with nonporous rubber inside surface and aging, ultraviolet, and abrasion-resistant fabric outer covering.

1. Rating: 50 psi (345 kPa) maximum working pressure with 180EF (82EC) coolant, and noncollapsible under vacuum.

2. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

I. Coolant piping external to engine generator set is as specified in Division 22 Section "Hydronic Piping."

2.7 FUEL SUPPLY SYSTEM

A. System complies with NFPA 30, "Flammable and Combustible Liquids Code," and NFPA 37, "Standard for Stationary Combustion Engines and Gas Turbines."

B. Fuel Piping: As specified in Division 22 Section "Fuel Piping Systems."

C. Fuel Storage Tank: As specified in Division 22 Section "Fuel Piping Systems.

D. Base Mounted Day Tank: Day tank shall be sized such that the generator shall operate for 48 hours at 100% load for a period of 48 hours. Features include the following:
1. Tank Level Indicator.
2. Vandal resistant fill cap.
3. Containment Provisions: Comply with requirements of authorities having jurisdiction."

2.8 ENGINE EXHAUST SYSTEM

A. Muffler: Critical-type, sized as recommended by the engine manufacturer. Measured sound level according to the "DEMA Test Code for the Measurement of Sound from Heavy-Duty Reciprocating Engines" at a distance of 10 feet from the exhaust discharge, is 85 dB "A" or less.

B. Connections from Engine to Exhaust System: Flexible section of corrugated stainless steel pipe.

C. Connection from Exhaust Pipe to Muffler: Stainless-steel expansion joint with liners.

D. Thimbles for Exhaust Piping: Conform to NFPA 211, "Chimneys, Fireplaces, Vents, and Solid-Fuel Burning Appliances."

2.9 STARTING SYSTEM

A. Description: 24 V electric with negative ground and including the following items:

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with the ambient temperature at the maximum specified in paragraph "Environmental Conditions."

2. Cranking Motor: Heavy-duty unit that automatically engages and releases from the engine flywheel without binding.

3. Cranking Cycle: As required by NFPA 110 for system level specified.

4. Cranking Cycle: 60 seconds. Adjustable crank and rest periods. After 3 cycles starter locks out and overcrank alarm is activated.

B. Battery System:

1. Battery complies with SAE J537, "Storage Batteries," and has adequate capacity within the ambient temperature range specified in paragraph "Environmental Conditions" to provide the specified cranking cycle series at least twice without recharging.

2. Battery Cable: Size as recommended by the generator set manufacturer for the cable length indicated. Include required interconnecting conductors and connection accessories.

3. Battery: Heavy duty lead-acid mounted on acid resistant rack. Battery sized to supply 60 seconds of continuous cranking while driving all components.

4. Battery Compartment: Factory-fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater is arranged to maintain battery above 10ºC regardless of external ambient temperature within range specified under "Environmental Conditions." Include accessories required to support and fasten batteries in place.

5. Battery Pad Heaters: Provide factory fabricated and installed heaters thermostatically controlled to maintain battery temperature to 10ºC regardless of external ambient temperature.

6. Battery-Charging Alternator: Factory-mounted on engine with solid-state voltage-regulation and 35 ampere minimum continuous rating. Internally protected from generator surges sized to fully charge dead batteries within 24 hours.

7. Battery Charger: Current limiting, automatic equalizing and float charging-type designed for operation from a 120 V 60 Hz supply source. Unit complies with UL 508, "Electrical Industrial Control Equipment," and includes the following features:

a. Operation: Equalizing charging rate of 10 amperes is initiated automatically after the battery has lost charge until an adjustable equalizing voltage is achieved at the battery terminals. The unit then automatically switches to a lower float-charging mode, and continues operating in that mode until the battery is discharged again.

b. Automatic Temperature Compensation: Adjusts the float and equalizes voltages for variations in the ambient temperature from minus 40ºC to plus 60ºC to prevent overcharging at high temperatures and undercharging at low temperatures.

c. Automatic Voltage Regulation: Maintains output voltage constant regardless of input voltage variations up to plus or minus 10 percent.

d. Ammeter and Voltmeter: Flush mounted in door. Meters indicate charging rates.

e. Safety Functions: Include sensing of abnormally low battery voltage arranged to close contacts providing "low battery voltage" indication on control and monitoring panel. Also include sensing of high battery voltage and loss of a.c. input or d.c. output of battery charger. Either of these conditions closes contacts that provide "battery charger malfunction" indication at system control and monitoring panel.

f. Enclosure and Mounting: NEMA Class 1 wall-mounted cabinet.

2.10 CONTROL AND MONITORING

A. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages are grouped on a common control and monitoring panel mounted on the generator set. Control and monitoring sections shall be isolated with steel barrier. Mounting method isolates the control panel from generator set vibration.

B. Indicating and Protective Devices, and Controls: Include those required by NFPA 110 for a Level 2 system plus the following:

C. Indicating and Protective Devices, and Controls: Include the following:

1. Meters: Provide the following meters, gauges, switches, and all associated switches, sensors etc.

   a. A.C. Voltmeter with phase selector switch.
   b. A.C. Ammeter with phase selector switches.
   c. A.C. Frequency Meter.
   d. D.C. Voltmeter (Alternator Battery Charging).
   e. Fuel level or pressure.
   f. Engine Coolant Temperature Gage.
   g. Engine-Lubricating Oil Pressure Gage.
   h. Running Time Meter.

2. Switches and Adjustment Devices:

   a. Start-Stop-Automatic mode selector switch.

   b. Generator Voltage-Adjusting Rheostat labeled “Voltage Adjustment” with a raise and lower arrows.

   c. Engine speed adjustment: labeled “Frequency Adjustment” with raise and lower arrows.

3. Automatic Safe Shutdown Devices: for the following

   a. Overspeed.
   b. High Coolant-Temperature.
   c. Low Coolant-Level.
   d. Low Oil Pressure.

D. Supporting Items: Include sensors, transducers, terminals, relays, and other devices, and wiring required to support specified items. Locate sensors and other supporting items on engine, generator, or elsewhere as indicated. Where not indicated, locate to suit manufacturer’s standard

E. Connection to Data Link: A separate terminal block factory-wired to Form C dry contacts for each alarm and status indication is reserved for connection for transmission of indications by data link to remote data terminals. Data system connections to terminals are covered in another Section.

F. Audible Alarms: Conform to NFPA 110 requirements for Level 2 systems and as follows. Include necessary contacts and terminals in control and monitoring panel. Locate audible device and silencing means where indicated. Provide a lamp test push button.

G. Audible Alarms: Signal occurrence of events listed below with individual pilot lights and common audible alarm. Locate audible device and silencing means where indicated. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Provide a lamp test push button.

1. High Engine Temperature Shutdown.
2. Low Coolant Shutdown.
3. Low-Lube Oil Pressure Shutdown.
4. Overspeed Shutdown.
5. Remote Emergency Stop Shutdown.
6. High Engine Temperature Pre-alarm.
7. Low-Lube Oil Pressure Pre-alarm.
8. Low Fuel Level or Pressure.
9. Battery-Charger Malfunction Alarm.
10. Low Battery-Voltage Alarm.
11. Low Coolant Temperature Alarm.
12. System Ready Indicating Light (non-alarm).
13. Overcrank Shutdown.
14. Control Switch Not in “Auto” position.

H. Remote Alarm Annunciator: Labeled LEDs indicate alarm events. Common audible signal sounds for alarm conditions. Silencing switch in face of panel silences signal without altering visual indication. Connect so that after an alarm is silenced, clearing of the initiating condition will reactivate the alarm until the silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

I. Remote Alarm: Provide auxiliary N.O. and N.C. contacts signal the required remote alarm.

J. Remote Control and Alarm Panel: Provide as required in NFPA 110.

K. Remote Emergency Stop Switch: Flush wall-mounted except as otherwise indicated and prominently labeled. Pushbutton is protected from accidental operation.

2.11 OUTDOOR GENERATOR SET ENCLOSURE

A. Description: Weatherproof steel housing. Multiple panels are lockable and provide adequate access to components requiring maintenance. Panels are removable by one person without tools.

B. Description: Prefabricated or pre-engineered walk-in enclosure with the following features:

1. Construction: Galvanized-steel, metal-clad, integral structural-steel-framed building erected on concrete foundation.

2. Structural Design and Anchorage: Comply with ASCE 7 for wind loads.

3. Space Heater: Thermostatically controlled and sized to prevent condensation.

4. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents.

5. Hinged Doors: With padlocking provisions.

6. Ventilation: Louvers equipped with bird screen and filter arranged to permit air circulation while excluding exterior dust, birds, and rodents.

7. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.

8. Muffler Location: [Within] enclosure.

C. Automatic Dampers: At air inlet and discharge. Dampers are closed to reduce engine and battery heat loss in cold weather when unit is not operating.

D. Air Flow Through Housing: Adequate to maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at the top of the range specified under "System Service Conditions."

E. Receptacle: Provide a 120V 20A duplex GFCI receptacle mounted in enclosure powered from accessory power supply.

2.12 ENCLOSURES

A. Outdoor Enclosures: Polyurethane enamel over corrosion-resistant pretreatment and manufacturer's compatible standard primer. Provide a 120V 20A duplex GFCI receptacle mounted in enclosure powered from accessory power supply.

2.13 ACCESSORY POWER PANELBOARD

A. Provide a 60 AMP 120V/240V 12 pole main circuit breaker panelboard in the generator enclosure. Include branch breakers, conduits and associate circuiting to provide power to the generator accessories.

2.14 VIBRATION ABSORPTION MOUNTS

A. Provide combination neoprene pads and springs.

PART 3 - EXECUTION

3.1 IDENTIFICATION

A. Identify system components according to Division 23 Section "Mechanical Identification" and Division 26 Section "Electrical Identification."

B. Nameplates: Each major system component is equipped with a conspicuous nameplate of the component manufacturer. Nameplate identifies manufacturer of origin and address, and the model and serial number of the item.

C. Provide warning sign, with white letters on red background reading: "Danger - Engine Generator May Be Extremely Hot; Generator May Start Automatically at Any Time." Sign to be weatherproof, easily legible from a ten-foot distance, and permanently fastened in an obvious location on or near engine generator set.

3.2 INSTALLATION

A. Anchor generator set and other system components according to manufacturer's recommendations.

B. Field Installation of Piping and Ductwork: As specified in Division 23 Sections "Basic Mechanical Materials and Methods" and "Hydronic Piping."

C. Manufacturer's Field Services: Arrange and pay for the services of a factory-authorized service representative to supervise the installing, connecting, pretesting, and adjusting of the unit.

3.3 GENERAL

A. Supervision: Installation of engine generator set to be under the direction of the manufacturer's authorized representative.

B. Install engine generator system as indicated with all necessary auxiliary equipment, support and accessories. All work to be in compliance with the manufacturer's written instructions.

3.4 ELECTRICAL

A. Wiring: Provide all auxiliary power and control wiring in conduit as required for proper operation of engine generator and all accessories. Make terminations at terminal blocks on engine generator set and in control panel. Identify all wires using conductor color coding and Brady (or other) numbered identification tape with identification corresponding to wiring schematic diagrams submitted with Shop Drawings. Use liquid-tight flexible metal conduit for all connections to engine generator set. Install all wiring and conduit of type suitable for temperatures encountered and so as to allow for thermal expansion.

B. Phase Sequence: Verify that generator phase sequence matches normal building system phase sequence, and correct if necessary.

C. Grounding: Ground all non-current carrying conductive parts of engine generator set to the generator grounding point as indicated. If generator is a separately derived system bond generator neutral per NEC 250 otherwise bond generator neutral to main service neutral bonding point.

D. Battery and Battery Charger: Install storage battery on rack on floor or frame, with required cables to engine and to battery charger. Wall mount battery charger, connect to dedicated 120-volt circuit as indicated, and connect to battery via fuse block adjacent to battery charger. Size fuses as recommended by manufacturer. Interlock battery charger with control panel to indicate any battery or charger malfunction. "Top off" battery storage cells.

E. Accessory Power: Connect accessory to available circuits or to generator mounted panelboard in which case circuit panelboard to available circuits.

F. Engine Start Circuit: Connect normally open engine start contacts at transfer switch(es) so that engine will be signaled to start upon loss of normal power at any or all transfer switch(es). Engine start circuit wiring to be #12AWG, and may run in emergency feeder conduits, and/or separate conduits.

G. Remote Annunciator: Install where indicated, and provide all wiring to generator control panel as required for proper operation.

3.5 ENGINE

A. Adjustments/Tuneups: Field verify and correct if necessary proper alignment of engine generator set. Field adjust voltage regulator and governor, and tune engine at site for optimum system performance.

B. After successful completion of performance test, replace engine air filter, and "top-off" engine lubricating oil and engine coolant as recommended by the manufacturer.

3.6 FUEL SYSTEM

A. General: Furnish accessories to Division 22 for installation of fuel piping system by Division 22. Coordinate entire installation of fuel system. Ensure that manual shut-off valve and solenoid valve are installed ahead of regulator and flexible fuel lines.

B. Fuel Source: Verify adequate fuel mix, pressure, etc.

C. Electrical: Make all required electrical connections to solenoid valve, low pressure sensor, etc. for proper operation.

3.7 COOLING SYSTEM

A. General: Coordinate installation of plenum connection from radiator to cooling air exhaust ductwork.

3.8 FUEL SUPPLY

A. Provide enough fuel of the type indicated to completely fill the fuel tank (s) for each generator. Tanks shall be topped off after completion of all testing required under this contract.

3.9 PRE-TEST VERIFICATION

A. Prior to testing engine generator set, perform all engine performance adjustments to manufacturer's standards, insure that all piping and wiring is complete, that proper air cooling is maintained, and that all auxiliaries are fully operational, to the satisfaction of the manufacturer's authorized representative. All tests shall be submitted in writing to owners representative for review prior to any tests being performed.

3.10 TESTING

A. Supervised Adjusting and Pretesting: Under supervision of factory-authorized service representative, pretest all system functions, operations, and protective features. Provide all instruments and equipment required for tests. Adjust to ensure operation is according to Specifications. Load system using a variable resistive and reactive load bank simulating kW, and power factor of loads for which unit is rated.

B. Tests: Provide the services of a qualified independent testing agency to perform the tests listed below according to manufacturer's recommendations upon completion of installation of system. Use instruments bearing records of calibration within the last 12 months, traceable to NIST standards, and adequate for making positive observation of test results. Include the following tests:

1. Insulation Tests: Test generator windings using 500 V d.c. for units rated up to 250 volts and 1000 V d.c. for units rated between 250 and 600 volts. Verify minimum insulation resistance is 25 megohms for units up to 250 volts, and 100 megohms for units 251 to 600 volts. Verify by dielectric absorption test that polarization index levels are according to IEEE 43, "Testing Insulation Resistance of Rotating Machinery."

2. Battery Tests: Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery. Verify acceptance of charge for each element of battery after discharge. Verify measurements are within manufacturer's specifications.

3. Battery Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

4. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.

5. Simulation of automatic operations, function and malfunctions to verify proper operation of local and remote protective, alarm, and monitoring devices.

6. Load Test: Use temporary variable load bank capable of simulating kVA, kW, at 1.0 power factor of load for which unit is rated. Run unit at 25, 50, and 75 percent of rated capacity for 30 minutes each, and at 100 percent for 3 hours. Record voltage, frequency, load current, battery-charging current, power output, oil pressure, and coolant temperature periodically during the test.

7. Vibration Baseline Test: Measure amplitude for nominal frequency and for frequencies 5, 10, 15, and 20 percent above and below nominal at each main bearing cap. Vibration levels not exceeding those specified in NEMA MG1, "Motors and Generators," are acceptable.

8. Cold Start Time: Record cold start time (only after generator set has been inoperative for at least 24 hours) required to bring generator set up to rated voltage and frequency.

9. Battery Test: Perform a battery test consisting of six cranking cycles of 10 seconds "On" and 10 seconds "Off." Replace batteries if they do not recharge to full value after test. Repeat until satisfactory conclusion.

10. Exhaust Emissions Test: Conform to applicable government test criteria.

11. Voltage and Frequency Transient Stability Tests: Record voltage and frequency transients for 50-percent and 100-percent step-load increases and decreases and verify that performance is as specified.

12. Harmonic Content Tests: Measure harmonic content of input and output current under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.

13. Battery Test: Test battery for 6 cranking cycles of 10 seconds on and 10 seconds off. Verify battery fully recharged after testing.

14. Efficiency Tests: Perform at 50 percent, 75 percent, and 100 percent of rated load.

C. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

3.11 COMMISSIONING

A. Battery Equalization: Equalize charging of battery cells according to manufacturer's instructions. Record individual cell voltages.

3.12 CLEANING

A. Upon completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.13 DEMONSTRATION

A. Training: Arrange and pay for the services of a factory-authorized service representative to demonstrate adjustment, operation, and maintenance of the system and to train Owner's personnel.

B. Conduct a minimum of 8 hours of training as specified under Instructions to Owner's Employees in the Project Closeout Section of these Specifications.

C. Schedule training with at least 7-day advance notice.

END OF SECTION 263213

Functional Performance Test
WATERBURY PUMP STATION

Project: WATERBURY PUMP STATION

Test Participants

Party	Participation
	Wendel

Date of Test: _____

The following functional performance test is for: Waterbury Pump Station. ***An ☒ denotes acceptance or compliance, N/A denotes not applicable and N/C denotes noncompliance.***

I. Test Prerequisites

☐ 1. Visual and Mechanical Inspection

a) ☐ Compare equipment nameplate data with drawings and specifications.

b) ☐ Inspect physical and mechanical condition.

c) ☐ Confirm correct application of manufacturer's lubricants.

d) ☐ Inspect anchorage and grounding. Verify that all grounding is in place and properly torqued.

e) ☐ Inspect all bolted electrical connections for high resistance using the following methods: Use of low-resistance ohmmeter.

f) ☐ Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturers published data.

g) ☐ Perform insulation-resistance tests in accordance with ANSI/IEEE Standard 43.

h) ☐ All generators: Record insulation-resistance value at one minute, test voltage, and winding temperature. Generators rated above 600 volts Test duration shall be for 10 minutes.

i) ☐ Inspect engine battery and battery charger output

II. LOAD TEST

1. ☐ Provide and connect a variable output rated load bank to generator under test. Load bank shall be able to test generator at 50% and 100% of rated load.

2. ☐ Connect a power quality monitoring meter* on output of the generator to measure the following parameters:

KW load	15 min	30 min	45 min	1 hour
Voltage A-B				
Voltage B-C				
Voltage C-A				
Voltage A-N				
Voltage B-N				
Voltage C-N				
Amps PH A				
Amps PH B				
Amps PH C				
Amps PH N				

*Power meter should be a DRANETEZ 658 or equal.

3. ☐ Start and load to 50% KW rating and hold for 1 hour documenting status every 15 minutes.

4. ☐ Start and load to 100% KW and hold for 1 hour documenting status every 15 minutes.

5. ☐ Transient Step Load Response, during transient load steps record the generator frequency.

Step	Description	Start KW	End KW	Frequency	Graphed By
Step 1	0% to 50% Load				
Step 2	50% to 100% Load				
Step 3	100% to 50% Load				
Step 4	0% to 100% Load				
Step 5	100% to 0% Load				

6. ☐ Functionally test engine shutdown for low oil pressure, over-temperature, over-speed, and other features as applicable.

7. ☐ Perform vibration baseline test. Plot amplitude versus frequency for each main bearing cap.

8. ☐ Verify correct functioning of governor and regulator.

Test Values

1. Polarization index values shall be in accordance with ANSI/IEEE Standard 43.

2. Vibration levels shall be in accordance with manufacturer's published data.

3. Performance tests shall conform to manufacturer's published data and ANSI/NFPA Standard 110.

III. THERMOGRAPHIC SURVEY
(Perform when generator is Loaded 100%)

Visual and Mechanical Inspection

1. ☐ Inspect physical, electrical, and mechanical condition.

2. ☐ Remove all necessary covers prior to thermographic inspection. Utilize appropriate caution, safety devices, and personal protective equipment.

3. ☐ Equipment to be inspected shall include all current-carrying devices.

4. ☐ Provide report including the following:

    a) Description of equipment to be tested.

    b) Discrepancies.

5. ☐ Temperature difference between the area of concern and the reference area.

    a) Probable cause of temperature difference.

6. ☐ Areas inspected. Identify inaccessible and/or unobservable areas and/or equipment.

    a) Identify load conditions at time of inspection.

7. ☐ Provide photographs and/or thermograms of the deficient area.

    a) Recommended action.

IV. MECHANICAL SYSTEMS LOGGING

1. Log generators mechanical systems

a) ☐ Record oil pressure during load test

b) ☐ Record water temperature during load test

c) ☐ Record fuel usage during load test

d) ☐ Battery Systems voltage

OIL PRESSURE	15min	30 min	45 min	1 hour
WATER TEMP				
FUEL USAGE				
BATTERY VOLTS				

Fluid sampling testing
(After load test)

1. Take: Fluid samples for fluid analysis

a) ☐ Coolant sample

b) ☐ Engine oil /gearbox sample

Notes:

_____

_____

_____

_____

_____

_____

-- END OF TEST --

SECTION 263600 (OPS) - SERVICE ENTRANCE AUTOMATIC TRANSFER SWITCHES (OFF-SITE PUMP STATION NO. 2)

PART 1 - GENERAL

1.1 SCOPE

A. Furnish and install service entrance automatic transfer switches (ATS) with number of poles, amperage, voltage, withstand and close-on ratings as shown on the plans. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.

B. Furnish an enclosure for the ATS that is for service entry. It shall provide all of the proper disconnecting, protection, grounding and bonding required for service entrance equipment.

1.2 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816, Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS

B. Product Data

1.3 CODES & STANDARDS

The service entrance automatic transfer switches and controls shall conform to the requirements of:

A. UL 1008 - Standard for Transfer Switch Equipment

B. IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment

C. NFPA 70 - National Electrical Code

D. NFPA 110 - Emergency and Standby Power Systems

E. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications

F. NEMA Standard ICS10-1993 (formerly ICS2-447) - AC Automatic Transfer Switches

G. UL 508 Industrial Control Equipment

H. UL 891 According to this UL standard the equipment shall be labeled “Suitable for use only as service Entrance.”

1.4 ACCEPTABLE MANUFACTURERS

A. Service Entrance Automatic Transfer Switches shall be ASCO 7000 Series. Any alternate shall be submitted for approval to the consulting engineer at least 10 days prior to bid. Alternate bids must list any deviations from this specification.

PART 2 - PRODUCTS

2.1 MECHANCIALLY HELD TRANSFER SWITCH

A. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include over-current disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.

B. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.

C. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.

D. All main contacts shall be silver composition. Switches rated 800 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.

E. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 800 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

F. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources, are not acceptable.

G. Where neutral conductors must be switched as shown on the plans, the ATS shall be provided with fully rated overlapping neutral transfer contacts. The neutrals of the normal and emergency power sources shall be connected together only during the transfer and retransfer operation and remain connected together until power source contacts close on the source to which the transfer is being made. The overlapping neutral contacts shall not overlap for a period greater than 100 milliseconds. Neutral switching contacts which do not overlap are not acceptable.

H. Where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated AL-CU pressure connectors shall be provided.

2.2 MICROPROCCESOR CONTROLLER

A. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.

B. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to ± 1% of nominal voltage. Frequency sensing shall be accurate to ± 0.2%. The panel shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from -55 to +85 degrees C.

C. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator's manual.

D. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.

E. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:

1.	EN 55011:1991	Emission standard - Group 1, Class A
2.	EN 50082-2:1995	Generic immunity standard, from which:
	EN 61000-4-2:1995	Electrostatic discharge (ESD) immunity
	ENV 50140:1993	Radiated Electro-Magnetic field immunity
	EN 61000-4-4:1995	Electrical fast transient (EFT) immunity
	EN 61000-4-5:1995	Surge transient immunity
	EN 61000-4-6:1996	Conducted Radio-Frequency field immunity
3.	IEEE472 (ANSI C37.90A) Ring Wave Test	

2.3 ENCLOSURE

A. The ATS shall be furnished in a Type 4X enclosure unless otherwise shown on the plans. A factory enclosure heater with thermostat shall be provided for NEMA 4X enclosures.

B. The Service Entrance ATS 400 amperes or less, shall be furnished in a single enclosure including a service (utility source) disconnect circuit breaker and an emergency source feeder disconnect circuit, as well as the power transfer switch, grounding and bonding provisions.

C. The Service Entrance ATS 600 amperes and above, shall be furnished in a multi-section switchboard as follows: a service equipment section containing the service (utility source)

disconnect circuit breaker, grounding, and bonding provisions; plus, a second non-service section containing the power transfer switch and controls.

D. All standard and optional door-mounted switches and pilot lights shall be 16-mm industrial grade type or equivalent for easy viewing & replacement. Door controls shall be provided on a separate removable plate, which can be supplied loose for open type units

E. A pressure disconnect link shall be provided to disconnect the normal source neutral connection from the emergency and load neutral connections for 4-mm wire applications. A ground bus shall be provided for connection of the grounding conductor to the grounding electrode. A pressure disconnect link for the neutral to ground bonding jumper shall be provided to connect the normal neutral connection to the ground bus.

F. For those automatic transfer & bypass-isolation switches that are less than 1000 amperes, the connection between the normal disconnecting device and the ATS shall be made with the appropriate size cable. For those automatic transfer & bypass-isolation switches that are greater than 1000 amperes, the connection between the normal disconnecting device and the ATS shall be made with appropriate size bus. Bus shall be silver plated copper.

2.4 DISCONNECTING AND OVERCURRENT PROTECTION DEVICE

A. For those service entrance automatic transfer switches less than 1000 amps, the normal connection shall be provided with a thermal magnetic, 3 pole, molded case circuit breaker with current ratings as shown on the plan. It shall have a thermal magnetic trip unit.

B. For those service entrance automatic transfer switches rated 1000 to 2000 amps, the normal connection shall be provided with a thermal magnetic, 3 pole, molded case breaker with current ratings as shown on the plans. The circuit breaker shall be provided with a ground fault trip function when required by the National Electric Code. The insulated case circuit breaker shall trip open when the ground fault setting is exceeded.

C. For those delayed transition transfer switches rated 3000 to 4000 amps the normal connection shall be provided with a stationary mount, insulated case circuit breaker with a solid state trip unit. The trip unit shall have adjustable long time, short time, instantaneous and ground fault trip settings. The circuit breaker shall trip open when the ground fault setting is exceeded.

2.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 3 - OPERATIONS

3.1 CONTROLLER DISPLAY AND KEYPAD

A. A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller.
   1. Nominal line voltage and frequency
   2. Single or three phase sensing
   3. Operating parameter protection
   4. Transfer operating mode configuration

(Open transition, Closed transition, or Delayed transition)

All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

3.2 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING

A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

Parameter	Sources	Dropout / Trip	Pickup / Reset
Undervoltage	N&E,3ϕ	70 to 98%	85 to 100%
Overvoltage	N&E,3ϕ	102 to 115%	2% below trip
Underfrequency	N&E	85 to 98%	90 to 100%
Overfrequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

B. Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 60°C.

C. Voltage and frequency settings hall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.

D. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).

E. Source status screens shall be provided for both normal & emergency to pro-vide digital readout of voltage on all 3 phases, frequency, and phase rotation.

F. The controller shall include a user selectable algorithm to prevent repeated transfer cycling to a source on an installation which experiences primary side, single phase failures on a Grounded Wye – Grounded Wye transformer which regenerates voltage when unloaded. The algorithm shall also inhibit retransfer to the normal (utility) source upon detection of a single phasing condition until a dedicated timer expires, the alternate source fails, or the normal source fails completely and is restored during this time delay period. The time delays associated with this feature shall be adjustable by the user through the controller keypad and LCD.

3.3 TIME DELAYS

A. An adjustable time time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.

B. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.

C. Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.

D. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.

E. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes:

1. Prior to transfer only
2. Prior to and after transfer.
3. Normal to emergency only.
4. Emergency to normal only.
5. Normal to emergency and emergency to normal.
6. All transfer conditions or only when both sources are available.

F. The controller shall also include the following built-in time delays for optional Closed Transition and Delayed Transition operation:

1. 1 to 5 minute time delay on failure to synchronize normal and emergency sources prior to closed transition transfer.
2. 0.1 to 9.99 second time delay on an extended parallel condition of both power sources during closed transition operation.
3. 0 to 5 minute time delay for the load disconnect position for delayed transition operation.

G. All time delays shall be adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in .01 second increments.

H. All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port.

3.4 ADDITIONAL FEATURES

A. A three position momentary-type test switch shall be provided for the *test / automatic / reset* modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.

B. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.

C. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.

D. LED indicating lights (16 mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).

E. The following features shall be built-in to the controller, but capable of being active through keypad programming or the serial port only when required by the user:

1. Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
2. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.
3. An Inphase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The Inphase monitor shall be specifically designed for and be the product of the ATS manufacturer. The Inphase monitor shall be equal to ASCO Feature 27.
4. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.
5. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:
   a. Enable or disable the routine.
   b. Enable or disable transfer of the load during routine.
   c. Set the start time:
      1) Time of day

2) Day of Week
3) Week of Month (1st, 2nd, 3rd, 4th, alternate or every)

d. Set the duration of the run

e. At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.

6. System Status - The controller LCD display shall include a "System Status" screen which shall be readily accessible from any point in the menu by depressing the "ESC" key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. For example: Normal Failed, Load on Normal, TD Normal to Emerg, 2min15s

   a. Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual, are not permissible.

7. Self Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.

8. Communications Interface – The controller shall be capable of interfacing, through an optional serial communication module, with a network of transfer switches, locally (up to 4000 ft.) or remotely through modem serial communications. Standard software specific for transfer switch applications shall be available by the transfer switch manufacturer. This software shall allow for the monitoring, control and setup of parameters.

9. Data Logging – The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:

   a. Event Logging
      1) Data and time and reason for transfer normal to emergency.
      2) Data and time and reason for transfer emergency to normal.
      3) Data and time and reason for engine start.
      4) Data and time engine stopped.
      5) Data and time emergency source available.
      6) Data and time emergency source not available.

   b. Statistical Data
      1) Total number of transfers.
      2) Total number of transfers due to source failure.
      3) Total number of days controller is energized.
      4) Total number of hours both normal and emergency sources are available

10. Communications Module – A ull duplex RS485 interface shall be installed in the ATS controller to enable serial communications. The serial communications shall be capable of a direct connect or multi-drop configured network. This module shall allow for the seamless integration of existing or new communication transfer devices. The serial communication interface shall be equal to ASCO Accessory 72A.

11. External DC Power Supply – An optional provision shall be available to connect an external 24 VDC power supply to allow the LCD and the door mounted control indicators to remain functional when both power sources are dead. This option shall be equivalent to ASCO accessory 1G.

PART 4 - ADDITIONAL REQUIREMENTS

4.1 WITH STAND AND CLOSING RATINGS

A. ATS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans.

B. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings. ATSs which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.

4.2 TESTS AND CERTIFICATIONS

A. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.

B. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.

C. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

D. The transfer switch system must contain a disconnect device on the normal source as well as a disconnect link on the utility neutral and a disconnect link between neutral and ground. The ATS manufacturer shall be certified to NEC 230.70, 230.70(B), 230.75 and 230.95.

PART 5 - EXECUTION

5.1 EXECUTION

A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details.

B. Outdoor Switch: Anchor to concrete by bolting.

1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."

C. Identify components according to Division 26 Section "Identification for Electrical Systems."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

E. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

F. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

5.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

    a. Check for electrical continuity of circuits and for short circuits.
    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    c. Verify that manual transfer warnings are properly placed.
    d. Perform manual transfer operation.

5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    c. Verify time-delay settings.

d. Verify pickup and dropout voltages by data readout or inspection of control settings.
e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

5.3 DEMONSTRATION

A. Training: Furnish the services of a factory-authorized service representative to instruct Owner's personnel in the operation, maintenance, an adjustment of transfer switches and related equipment. Provide a minimum of 4 hours of instruction scheduled 7 days in advance

END OF SECTION 263600 (OPS)

SECTION 263600 TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Comply with Division 1 - General Requirements, as well as Division 1 High Performance Buildings Requirements, Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5

a. The above HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Description of Work: Provide transfer switches and associated equipment indicated.

C. Related Sections: All Division 26 Sections contain requirements that relate to this Section.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Wiring diagrams, elementary or schematic, differentiating between manufacturer-installed and field-installed wiring.

D. Single-line Diagrams: Showing transfer switch connections between transfer switch, bypass/isolation switch, power source, and load, plus interlocking provisions.

E. Operation and Maintenance Data: For each type of product, for inclusion in Operating and Maintenance Manual specified in Division 1. Include all features and operating sequences, both automatic and manual. List all factory settings of relays and provide relay setting and calibration instructions.

F. Manufacturer's Certificate of Compliance: Verification that each switch provided meets all the requirements herein, referenced standards and that the tested short-circuit closing and withstand ratings applicable to the protective devices and current ratings used in this Project, are as indicated and as specified in paragraph "Tested Fault Current Ratings."

G. Submittals: All submittals shall be neatly bound 8-1/2" x 11" logically organized and with a table of contents.

1.4 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Transfer Switches submittal to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Transfer Switch manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms are experienced in manufacturing the same or similar equipment of the types and capacities indicated for the last 5 years. Firms shall have a record of successful in-service performance and shall upon request submit examples of successful equipment applications, with project engineer and end user contacts and phone numbers.

B. Emergency Service: Manufacturer maintains an authorized service center capable of providing emergency maintenance and repairs at the Project site with an 4-hour maximum response time.

C. Comply with NFPA 70, "National Electrical Code," for components and installation.

D. Comply with NFPA 99, "Standard for Essential Electrical Systems for Health Care Facilities," and NFPA 110, "Standard for Emergency and Standby Power Systems."

E. Comply with NEMA ICS 1, "General Standards for Industrial Control," ICS 2, "Industrial Control Devices, Controllers and Assemblies," and ICS 6, "Enclosures for Industrial Controls and Systems."

F. Nationally Recognized Testing Laboratory Listing (NRTL) and Labeling: Items furnished under this Section are listed and labeled by a NRTL for emergency service under UL Standard 1008.

1. Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

G. UL Listing and Labeling: Items furnished under this Section shall be UL listed and labeled under UL Standard 1008, "Automatic Transfer Switches." Requirements herein shall take precedence where requirements of these Specifications are stricter.

H. Single-Source Responsibility: Obtain all equipment and accessories for each ATS from a single manufacturer that assumes responsibility for all system components furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provided by the following:

1. Automatic Switch Co.
2. Caterpillar, Inc.
3. Kohler Co.

2.2 TRANSFER SWITCH PRODUCTS

A. General: Double throw, unless otherwise noted, mechanically held power transfer switches. The use of circuit breakers, contactors, etc. not intended for continuous repetitive switching duty is prohibited.

B. Number of Poles and Current and Voltage Ratings: As indicated.

1. Units 400 amperes and larger shall be suitable for 30-percent-maximum tungsten filament lamp load.

C. Neutral Terminal: Where 2- or 3-pole switches are indicated, provide fully rated, solid, unswitched neutral terminal except as indicated.

D. Neutral Switching: Where a switch neutral is required full-capacity neutral overlapping transfer.

E. Tested Fault-Current Ratings: Closing and withstand ratings of each switch shall exceed the indicated available rms symmetrical fault current at the equipment terminals based on testing according to UL Standard 1008, conducted at full-rated system voltage and 20 percent power factor. Rate each product for withstand duration time as follows when tested for rated short-circuit current correlated with the actual type of circuit protective device indicated for transfer switches for this Project. Contractor shall ensure the switch meets the requirements of the system with the exact overcurrent protection to be provided.

F. Overcurrent Protection: Provide overcurrent protection as specified in other Division 26 Sections and below:

1. Molded-Case Circuit Breakers, 150 Amperes or Smaller: 1.5 closing and withstand duration cycles.

2. Molded-Case Circuit Breakers, Larger than 150 Amperes: 3 closing and withstand duration cycles.

3. Power Circuit Breakers: 10 closing and withstand duration cycles.

4. Current-Limiting Fuses: 0.5 (nominal) closing and withstand duration cycles.

G. Solid-State Controls: Repetitive accuracy of all settings is plus or minus 2 percent or better over an operating temperature range of minus 20ºC to 70ºC.

H. Resistance to Damage by Voltage Transients: Components meet or exceed voltage surge withstand capability requirements when tested according to ANSI C37.90.1, IEEE Guide for Surge Withstand Capability (SWC) Tests. Components meet or exceed voltage impulse withstand test of NEMA ICS 1.

I. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated are double the nominal rating of the switch.

J. Switch Contacts: Use silver composition for switching load current. Units rated 225 amperes and more have separate arcing contacts.

K. Enclosures: General-purpose NEMA 1, conforming to UL Standard 508, “Electric Industrial Control Equipment,” except as otherwise indicated.

L. Accessibility: Inspection of all contacts shall be possible from the front of the switch without disassembly while the switch is in use. Provide a manual handle to permit switch interruption at any point to view the contacts.

M. Heater: Within enclosure of units exposed to outdoor temperature and humidity conditions, connect thermostat within enclosure to control heater.

N. Factory Wiring: Train and bundle factory wiring and identify consistently with shop drawings, either by color code or by numbered or lettered wire and cable tape markers at terminations.

1. Designated terminals accommodate field wiring.

2. Power Terminals Arrangement and Field Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.

3. Terminals: Pressure-type, suitable for copper or aluminum conductors of sizes indicated.

4. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

O. Electrical Operation: Where indicated, accomplish by a nonfused, momentarily energized solenoid or electric motor-operated mechanism, mechanically and electrically interlocked in both directions. Switches using components of molded-case circuit breakers or contactors not designed for continuous-duty, repetitive switching between active power sources are not acceptable.

P. Terminals: Provide terminals to:

1. Remote indication of switch transfer to emergency source
2. Prevent transfer to either source.

2.3 AUTOMATIC TRANSFER SWITCHES (ATSs)

A. NFPA Compliance:

1. NFPA 101: Comply with Level 1 equipment according to NFPA 110, “Standard for Emergency and Standby Power Systems.”

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning except as indicated.

C. Digital Communications Interface: Full-duplex RS 422 type, matched to capability of remote annunciator or annunciator and control panel.

D. ATS for Large Motor Loads: Where indicated, ATS includes factory-installed and factory-wired internal motor control undervoltage and timing relays. Relays control designated starters to de-energize motors prior to transfer and re-energize them selectively at adjustable time intervals after transfer. Control connection to motor starters is through wiring external to the ATS. Time delay for individual motor loads is adjustable between 1 and 60 seconds and settings are as indicated. Relay contacts are rated for actual motor-control circuit inrush and seal currents, or for pilot duty as indicated.

E. Automatic Transfer Switch Features:

1. Settings: All adjustable settings shall be field adjustable without the use of tools, meters, and power supplies.

a. Voltage sensing for each phase of normal source. Pick-up voltage is adjustable from 85 percent to 100 percent nominal, and drop-out voltage is adjustable from 75 percent to 98 percent pick-up value with 1% increments. Factory set for pick-up at 90 percent and drop-out at 85 percent.

b. Voltage and frequency sensing for one ungrounded phase of the emergency power source.

c. Time-delay override of normal source voltage-sensing delays transfer and engine start signals. Adjustable 0 to 5 minutes, and factory set at 1 second.

d. Voltage/Frequency Lockout Relay: Prevent premature transfer. Voltage pick-up is adjustable from 85 percent to 100 percent nominal. Factory set to pick-up at 90 percent. Pick-up frequency is adjustable from 90 percent to 100 percent nominal. Factory set to pick-up at 95 percent.

e. Retransfer Time Delay: Adjustable from 0 to 30 minutes and factory set at 10 minutes. Provides automatic defeat of the delay upon loss of voltage or sustained undervoltage of the emergency source, provided the normal supply has been restored.

2. Operating Switches:

a. Manual Switch Operation: Manually operated under load with the door closed with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

b. Test Switch: Simulates normal source failure.

c. Transfer Override Switch: Overrides automatic retransfer control so the ATS will remain connected to the emergency power source regardless of the condition of the normal source. A pilot light indicates the override status.

3. Indicating Lights:

a. Switch-Position Pilot Lights: Indicate source to which the load is connected.

b. Source-Available Indicating Lights: Supervise sources via the transfer switch normal and emergency source-sensing circuits.

1.) Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."

2.) Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

4. Contacts:

a. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

b. Unassigned Auxiliary Contacts: Two normally open SPDT contacts for each switch position.

1.) Rating: 10 amperes at 240 V a.c.

c. Engine Starting Contacts: One isolated normally closed and 1 isolated normally open. Contacts are gold flashed or gold plated and rated 10 amperes at 32 V d.c. minimum.

d. Engine Shut-Down Contacts: Instantaneous, to initiate shut-down sequence at remote engine-generator controls after retransfer of the load to normal or preferred source.

e. Engine Shut-Down Contacts: Time delay adjustable from 0 to 5 minutes; factory set at 5 minutes.

5. Engine-Generator Exerciser: Solid-state programmable time switch starts engine-generator set and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiate exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory-set periods are for 7 days and 20 minutes, respectively. Exerciser features include:

a. Exerciser transfer selector switch, which permits selection between exercise with and without load transfer.

b. Push button programming controls with digital display of settings.

c. Integral battery operation of time switch when normal control power is not available.

2.4 FINISHES

A. Enclosures: Manufacturer's standard enamel over corrosion-resistant pretreatment and primer.

2.5 SOURCE QUALITY CONTROL

A. Factory test components, assembled switches, and associated equipment to ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for conformance with specified requirements. Perform dielectric strength test conforming to NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Floor Mounting of Transfer Switches: Level and anchor the unit to the floor.

B. Annunciator Panel Mounting: Mount flush in wall except as indicated.

C. Identify components according to Division 26 Section "Electrical Identification."

3.2 WIRING TO REMOTE COMPONENTS

A. Match the type and number of cables and conductors to the control and communications requirements of the transfer switches used. Increase raceway sizes at no additional cost to the owner if necessary to accommodate required wiring.

3.3 CONNECTIONS

A. Tighten factory-made connections, including connectors, terminals, bus joints, mountings, and grounding. Tighten field-connected connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque tightening values. When manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and 486B.

3.4 GROUNDING

A. Make equipment grounding connections for transfer switch units as indicated and as required by the NEC.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise field tests.

B. Adjustments and Calibrations: Verify all settings are accurate and test/calibrate all sensing, timing, meters, and control devices.

C. Preliminary Tests: Perform electrical tests as recommended by the manufacturer and as follows:

1. Measure phase-to-phase and phase-to-ground insulation resistance levels with insulation resistance tester, including external annunciator and control circuits. Use test voltages and procedure recommended by the manufacturer. Meet manufacturer's specified minimum resistance.

2. Check for electrical continuity of circuits and for short circuits.

D. Field Tests: Give 7-day advance notice of the tests and perform tests in presence of owner's representative.

E. Coordinate tests with tests of generator plant and run them concurrently.

F. Tests: As recommended by the manufacturer and as follows:

1. Contact Resistance Test: Measure resistance of power contacts for ATSs, NATSs, and BP/ISs. Resolve values in excess of 500 micro-ohms and differences between adjacent poles exceeding 50 percent.

2. Ground Fault Tests: Coordinate with testing specified in Division 26 Section "Overcurrent Protective Devices" to ensure sensors are properly selected and located to optimize ground-fault protection where power is being delivered from either source.

a. Verify grounding points and sensor ratings and locations.

b. Apply simulated fault current at the sensors and observe reaction of circuit interrupting devices.

3. Operational Tests: Demonstrate interlock, sequence, and operational function for each switch at least 3 times.

a. Simulate power failures of normal source to ATSs and of emergency source with normal source available.

b. Simulate low phase-to-ground voltage for each phase of normal source of ATSs.

c. Verify time-delay settings and pick-up and drop-out voltages.

G. Test Failures: Correct deficiencies identified by tests and prepare for retest. Verify that equipment meets the specified requirements.

H. Reports: Maintain a written record of observations and tests. Report defective materials and workmanship and retest corrected items. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.6 DEMONSTRATION

A. Training: Furnish the services of a factory-authorized service representative to instruct Owner's personnel in the operation, maintenance, and adjustment of transfer switches and related equipment. Provide a minimum of 4 hours of instruction scheduled 7 days in advance.

END OF SECTION 263600

SECTION 264113 - LIGHTNING PROTECTION SYSTEM (PERFORMANCE)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5

a. The above HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents.

B. Provide lightning protection for the following:

1. All new structures, buildings and fences, mechanical/electrical apparatus.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Provide plan drawings based on and at the same scale as building contract drawings.

D. Submittals prepared by system supplier, include UL control numbers for components and installer.

E. Submit grounding plan for ground electrodes, and calculations of grounding resistance based on soil resistivity at lowest moisture content.

F. Written report from equipment manufacturer's field representative certifying compliance with codes, regulations and permits.

1.5 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Lightning Protection System to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Lightning Protection System manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.7 DESCRIPTION OF SYSTEM

A. Provide a complete system of lightning protection designed for a steel frame structure not exceeding 75 ft. - 0 in. in height. Provide system in strict compliance with United Lightning Protection Association (ULPA) recommendations, National Fire Protection Association "Lightning Protection Code," and Underwriters Laboratories "Installation Requirements".

B. Provide complete equipment, accessories and installation for protection against damage by lightning. Provide terminals, roof conductors, down conductors, ground conductors, installed in a neat, concealed manner so that the complete work is unobtrusive and does not detract from the building or facility appearance.

1.8 CODES, REGULATIONS, PERMITS

A. Comply with applicable federal, state, municipal laws, ordinances and regulations.

B. Comply with provisions of the latest codes and regulations for protection against lightning as adopted by the National Fire Protection Association (NFPA-780), Underwriter's Laboratories, Inc. (UL-96A), and Standard Committee of United Protection Association.

C. Provide materials and equipment that are approved by UL for use on a lightning protection system and that are of size, weight and composition required by UL and NFPA.

D. Provide an Underwriter's Laboratories, Inc. Master Label.

1.9 SYSTEM SUPPLIERS

A. Materials shall be the product of a lightning protection system manufacturer regularly engaged in the lightning protection equipment and systems.

B. System supplier shall be regularly engaged in the installation of lightning protection equipment and systems and shall be approved by the United Lightning Association and Underwriter's Laboratories, Inc.

C. Make: Crowley Lightning Protection, Inc., Harger Lightning Protection .or Heary Bros.

1.10 SERVICE AND TESTING

A. Provide the services of the equipment manufacturer's factory representative to inspect the completed system.

B. Provide a written report submittal stating system installation complies with codes, regulations and permits.

C. The completed lightning protection system shall be fully tested in the presence of the Owner's Representative to demonstrate continuity of all conductors and to verify conformance with UL Standards.

D. Provide initial soil resistivity test as basis of ground electrode system.

E. Testing equipment shall be designed for specific tests required. Submit test procedures as part of submittal.

PART 2 - PRODUCTS

2.1 AIR TERMINALS

A. General: provide air terminals extending not less than 12 in. above the object they protect; proper base support for surface on which mounted; securely anchored mounting surface; provide lead sheath where required.

B. Class I:

1. Solid: Minimum 3/8 in. diameter solid copper with tapered nickel point, length as required by building construction, and roof areas.

2. "Radioactive" or "Ionizing": Types:

3. Shall not be provided or designed into the system.

2.2 MAIN CONDUCTORS

A. Class I Copper Conductor: Commercially pure copper cable; minimum size each strand 17 AWG, weight not less than 235 lbs. per thousand feet; 68,500 circular mils.

B. Mesh commercially pure solid copper wire, 2 in, centers 100% welded construction.

C. Solid stainless steel or copper conductor having equal conductivity, shall be used to provide mechanical strength or corrosion-resistance in specific locations, as required by ULPA recommendations.

2.3 BONDING CONDUCTORS

A. Class I Copper Conductor: Commercially pure copper cable; minimum size each strand 14 AWG, weight not less than 135 lbs. per thousand feet; 43,000 circular mils.

B. Class I Copper Solid Strip: Commercially pure copper; minimum thickness 16 AWG, minimum width 1 in.

C. All other cables shall be stranded copper, size and weight as approved and required for Class II applications.

2.4 GROUND ELECTRODES

A. Ground electrodes shall be 5/8 in. x 10 ft. minimum stainless steel, copper clad steel or solid copper ground rods.

2.5 BRACKETS

A. Provide heavy duty brackets complete with hardware and anchors, fabricated from nonferrous metals.

2.6 CONNECTORS, FITTINGS, FASTENERS, AND HARDWARE

A. Provide connectors, fittings, fasteners, hardware, clamps, guards, bonding straps and jumpers, bushings, lugs, and accessories, as required to connect, interconnect, and install all parts of the system and connect building metals and equipment.

B. Fabricated from non-ferrous metals, for use intended.

C. Provide non-corrosive connections between dissimilar metals/

2.7 SURGE PROTECTIONS

A. Provide surge arrestor for electric service entrance, telephone service entrancetelevision service lead-in, fire alarm service lead-in, signal systems.

2.8 SYSTEM PRODUCT MAKES

A. Make: Harger Lightning Protection, Inc.,,Heary Bros. Lightning Protection or Crowley Lightning Protection .

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. Install in a professional manner by qualified personnel regularly engaged in and experienced in this type of Work.

B. Down connectors shall be concealed.

C. Concealed conductors shall be installed in Schedule 40 PVC conduit, 1 in. minimum size. Provide conduit in accordance with reviewed submittal drawings.

D. Installation in accessible locations shall be properly guarded and protected.

E. Prevent electrolytic or galvanic action between dissimilar metal parts.

F. Roof, wall, or other building penetrations shall be made in a manner to prevent the ingress of water or moisture.

1. Coordinate all roof penetrations with roofing contractor.

G. Sleeves shall be provided where conductors pass through building floor. Bond each end of rigid steel galvanized metal sleeve or conduit run to cable with fusion weld.

H. Install system in a manner to eliminate possibility of system displacement due to lightning or maintenance of facility.

I. Connections shall be mechanically sound and essentially zero impedance electrically and mating surfaces shall be cleaned and brightened just prior to attachment.

3.2 INSTALLATION - AIR TERMINALS

A. Install air terminals within 2 ft. of the edge of structure and at intervals not greater than 20 ft. along facility perimeter and peak. Provide additional terminals to limit spacing across roof to 50 ft. maximum. Provide quantity of air terminals as required for all roof perimeters and centers, penthouses, and vertical projections.

B. Install so that tip projects 12 in. minimum above the object which it protects.

C. Provide compatible roof flashing at each terminal or conductor penetration of the roof to conform to Division 7 requirements.

1. Minimize roof penetration by adhering base of terminal or conductor clamp to surface of roofing material.

3.3 INSTALLATION - CONDUCTORS

A. Conductor Coursing:

1. All main conductors shall maintain a continuous downward course, free from "U" or "V" pockets; no conductor shall form an angle of more than 90° or have a bend radius of less than 8 in.

2. Inductance bonding conductors shall follow the most indirect route, preserving where possible, a downward or horizontal course to main conductor.

3. Roof conductors shall interconnect and provide a two-way path from each air terminals; conductors on perimeters of flat roofs shall form closed loops.

4. Down conductors, where required, shall follow the most direct path possible between roof conductors and ground terminals; do not provide deep re-entrant loops.

B. Conductors shall be securely supported and fastened at not more than 3 ft. - 0 ft. intervals.

3.4 INSTALLATION - INTERCONNECTION OF METALS

A. Ungrounded sizeable metallic objects or surfaces within 16 ft. of the system, presenting capacitance or inductance hazards and metal connected to the system shall be interconnected and bonded to the lightning protection system with approved fittings and conductor.

B. Copper materials connecting to steel shall be lead coated.

C. Connections between other dissimilar metal shall be made with approved bi-metallic connectors.

3.5 INSTALLATION - CONDUCTOR TO GROUND CONNECTIONS

A. Conductor to ground connections shall be provided around the perimeter of building, and in no case shall average over 60 ft. apart when structural steel frame is used for down conductors or 100 ft. apart for a cable system.

B. The structural steel frame may substitute for main down conductors provided the frame is electrically continuously and of adequate cross section. When the steel frame is utilized, connect the roof conductor to steel at least as often and at the same column as ground connections. Make connections to steel with thermoweld whenever possible. Provide bonding at structural connections as required to make the entire metal frame continuous.

3.6 INSTALLATION - GROUND ELECTRODES

A. Provide a suitable earth electrode at each down conductor.

B. Volume and type of soil and the lowest expected moisture content at each grounding location shall determine the extent of the grounding arrangement.

C. Meet or exceed requirements of UL 96A.

D. Owner's Representative will observe the installation of each ground terminal.

E. Provide an accurate record of the type and location of each ground terminal. Submit to Owner's Representative before final acceptance, and obtain signed receipt.

F. Ground rods shall be driven to full depth ion soil undisturbed by building excavation and shall not be driven into excavation backfill area.

3.7 INSTALLATION - COMMON GROUND

A. Grounding mediums on or on a structure shall be interconnected to provide a common ground potential and shall include lighting protection, electric, telephone, communication and signal system grounds as well as all underground utility services metallic piping systems such as water, sewer, gas, steam , condensate, chilled water, underground conduits, and other building and site systems.

B. Main size lightning conductors shall be used for interconnecting these ground systems to the lightning protection system.

C. Ground connection shall be provided to the water systems where water supply enters the building.

3.8 FIELD QUALITY CONTROL

A. Provide an accurate record of each ground connection location and identify each location and each field modification on a reproducible copy of the reviewed shop drawings. Submit three copies prior to final acceptance, subject to Owner's Representative acceptance.

B. Log continuity tests of metal framing, ground connections, bonding. Indicate location and type of test, test results, and instruments used to make test. Submit to Owner's Representative and obtain receipts prior to final acceptance.

C. Provide a UL inspection of the completed installation and provide the UL Master Label. Install label at location acceptable to UL and Owner's Representative and provide copy in O&M manual.

D. Provide a letter certifying dates of UL inspection during construction, submit to Owner's Representative.

END OF SECTION 264113

SECTION 265100 INTERIOR LIGHTING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Description of Work: Provide lighting fixtures and all accessories as indicated or required.

C. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-4(b)9

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 LIGHTING FIXTURE TYPES

A. A lighting fixture type is indicated adjacent to each lighting fixture shown on the Drawings. (e.g. “F1,” “F2,” “H1,” etc.). Where all the fixtures in a room or area are identical, the type may be indicated only once. Refer to the Lighting Fixture Schedule. Request fixture type for any lighting fixture without a type indicated.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.5 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Lighting Fixtures to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Lighting Fixtures specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES - GENERAL

A. Types: As described in the Lighting Fixture Schedule. Lighting fixture manufacturers' series or catalog numbers listed indicate general quality, type, and style, but may not cover all required design features and details. Provide lighting fixtures having all features details and accessories as noted in the fixture descriptions and in this specification section.

B. Design and Construction: Free of light leaks and so as to provide adequate ventilation for lamp(s) and ballast(s).

C. Lampholders: Shall make positive contact with lamp base or pins and shall securely hold lamps in place.

D. Light Control: Reflectors, diffusers, lenses, louvers, baffles, etc. as indicated in the Lighting Fixture Schedule.

E. Accessories: As indicated and as required.

2.2 FLUORESCENT FIXTURES (EXCEPT COMPACT TYPES)

A. General: Below are minimum fixture construction requirements.

1. Housing: Minimum 22 gauge rust protected steel, or minimum .125" aluminum construction.

2. Finish: White baked enamel, unless indicated otherwise.

3. Reflectors: Minimum 85% reflectance.

4. Lamp Holders: Medium bi-pin with edge wipe contacts.

5. Lenses: Unless indicated otherwise, extruded, clear, light stable, 100% virgin acrylic, minimum .125" thick.

6. Parabolic Louvers: Unless indicated otherwise, minimum .025 thick, semi-specular anodized aluminum, permanently de-staticized to retard dirt accumulation, and with depths as indicated.

2.3 LED LAMPS

A. Color: Match 3500K interior, 4500K site and parking lot lighting.

B. Life: Minimum 40,000 before 20% loss of output.

C. Manufacturers: Philips, Cree,, OSRAM.

2.4 CEILING MOUNTED FIXTURES

A. Fixtures, in general, have been specified for the particular type of ceiling where they are being installed. However, the Contractor shall verify all ceiling construction types prior to ordering light fixtures, and order lighting fixtures accordingly. Verify the exact ceiling system construction types and provide lighting fixtures, fittings, hangers, clamps, brackets, yokes, plaster flanges and miscellaneous devices as required for a complete installation to suit the ceiling construction.

2.5 PENDANT MOUNTED FIXTURES

A. Provide all necessary hardware, single-piece stems and miscellaneous components for a complete installation. When necessary for sloped ceilings, provide swivel type pendant hangers. For continuous row installations provide alignment hardware which spans adjacent fixtures.

2.6 CHAIN SUSPENDED FIXTURES

A. Install outlet box directly above fixture. Provide three conductor type SJO cord with NEMA L5-15 (120 volt) or NEMA L7-15 (277 volt) connecting plug and receptacle for each fixture.

2.7 DAMP AND WET LOCATION FIXTURES

A. UL Damp (or Wet) label, with corrosion resistant, weatherproof enamel or epoxy finish, and stainless steel or anodized aluminum fasteners.

2.8 LAMPS AND BALLASTS

A. Refer to 265110 - Lamps and Ballasts, and the Lighting Fixture Schedule.

PART 3 - EXECUTION

3.1 GENERAL

A. Install lighting fixtures as described in the Lighting Fixture Schedule, complete with lamps and ballasts. Install all necessary accessory fittings, hangers, clamps, brackets, yokes, plaster flanges, outlet boxes, and miscellaneous devices required for a complete installation as recommended by the manufacturer.

3.2 FIXTURE MOUNTING AND SUPPORT

A. General: Securely support and/or suspend all lighting fixtures from structural members or the building. Lay-in, flanged, and recessed downlight fixtures may be supported by the framing members of the suspended ceiling system, where secured per NEC 410-16c. Secure troffers to ceiling tees at least twice along each long side of troffer.

B. Mounting Heights: Suspend pendant mounted lighting fixtures at heights indicated, measured from finished floor to bottom of fixture enclosure or reflector unless noted otherwise. Install wall mounted fixtures at heights indicated measured from finished floor to center of fixture outlet box unless noted otherwise.

C. Recessed Lighting Fixtures: Provide flexible connections to all recessed lighting fixtures as required by the code and in accordance with approved wiring methods.

D. Track Lighting Fixtures: Track must be supported and installed per NEC 410-101.

E. Fixtures on sound control ceilings: Pendant mount with only a conduit penetration coordinate with ceiling manufacture all penetrations to maintain ceiling integrity.

3.3 LAMPS

A. Install specified lamps as recommended by the lamp and lighting fixture manufacturers. Follow lamp manufacturer’s recommendations for handling and installing lamps.

3.4 BALLASTS

A. Make all field connections necessary for factory installed ballasts and install all special ballasts as recommended by the manufacturer.

3.5 FINAL ACCEPTANCE

A. Acoustically treated assembly areas: Provide a mock-up of field sound test for final acceptance of fixtures by project consultant.

B. Coordinate with settings with Owner's representative and make all aiming adjustments for applicable fixtures.

3.6 OPERATION

A. Verify all fixtures are operational per specifications and manufacturers recommendations.

END OF SECTION 265100

SECTION 265110 LAMPS AND BALLASTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Description of Work: Provide lamps and ballasts for lighting fixtures as indicated.

C. Related Sections:

1. Division 01, High Performance Buildings Requirements Section 018113.13. for credits 16a-38k-4(b)4, 16a-38k-4(b)5

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.4 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Lamps and Ballasts to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Lamps and Ballasts specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 SUBMITTALS

A. Product Data: For each lighting fixture submittal (refer to 265110 and 265100) indicate the respective lamp and ballast manufacturer and model number or series to be provided with each lighting fixture.

PART 2 - PRODUCTS

2.1 GENERAL

A. Types: All lamps shall be as specified below, as indicated in the Lighting Fixture Schedule, and in accordance with the lighting fixture manufacturer's requirements.

B. All lamps must comply with the National Energy Policy Act of 1992 (EPACT).

C. Nomenclature: Lamp nomenclature for various types of lamps is used only to establish standards of quality and performance.

2.2 INCANDESCENT LAMPS

A. General Electric Lamp Nomenclature Used.

B. General purpose, inside frosted, unless indicated otherwise. Acceptable Manufacturers: General Electric; Osram Sylvania; Philips.

C. Rough Service Lamps: Provide for all lighting fixtures mounted in air handling units or other areas subject to vibration.

D. PAR Lamps: Medium screw base, without diode or any other design feature which limits dimmability. Acceptable Manufacturers: General Electric; Osram Sylvania; Philips.

E. Tungsten Halogen Lamps: Minimum rated life of 2500 hours, color temperature of 3000EK, CRI of 100, dimmable. Acceptable Manufacturers: General Electric; Osram Sylvania.

2.3 FLUORESCENT LAMPS (EXCEPT COMPACT TYPES)

A. General Electric Lamp Nomenclature Used.

B. All lamps to be tri-phosphor, energy saving, rapid start or instant start type. Lamp color temperature to be 3500ºK with CRI ≥ 75 unless indicated otherwise.

C. All lighting fixtures shall be lamped as indicated on the lighting fixture schedule. Fluorescent lamps shall be low mercury TCLP compliant, as manufactured by General Electric, Phillips, Osram Sylvania, or Venture.

D. All F32T8 (32 watt) lamps shall meet the Consortium for Energy Efficiency (CEE) High Performance T8 (HPT8) specifications and have a minimum color rendering index of 85, a "Mean System Efficacy of ≥90 MLPW for instant start ballast, ≥ than 88 MLPW for programmed start ballast, minimum initial lamp lumens ≥3100, Minimum mean lumens ≥ 2900, Lamp life ≥ than 24,000 hours at three hours per start, and a color temperature of 3500K.

E. All F28T5 (28 watt) lamps are to have a minimum color rendering index of 85, a minimum efficacy of 103 lumens per watt, and a color temperature of 3500K.

F. All F24T5HO (24 watt) lamps are to have a minimum color rendering index of 85, a minimum efficacy of 83 lumens per watt, and a color temperature of 3500K.

G. All F54T5HO (54 watt) lamps are to have a minimum color rendering index of 85, a minimum efficacy of 92 lumens per watt, and a color temperature of 3500K.

2.4 COMPACT FLUORESCENT LAMPS

A. General Electric lamp nomenclature used.

B. Single-ended twin-tube or double twin-tube (quad) as indicated. Lamp color temperature to be 3500ºK with CRI ≥ 82 unless indicated otherwise.

C. Acceptable Manufacturers: General Electric "BIAX" Series; Osram Sylvania "DULUX" Series; Philips "PL" Series.

2.5 METAL HALIDE LAMPS

A. Venture lamp nomenclature used.

B. Select lamps for proper burning position.

C. Acceptable Manufacturers: Venture; Osram Sylvania; no substitutes.

2.6 LED LAMPS

A. Color: Maatch 3500K interior, 4500K site and parking lot lighting.

B. Life: Minimum 40,000 before 20% loss of output.

C. Manufacturers: Philips, Cree, OSRAM.

2.7 BALLASTS

A. General: High power factor type rated for system voltage and frequency with an "A" sound rating when available unless indicated otherwise, or with the quietest sound level rating available from the approved ballast manufacturers. Secure ballasts with removable fasteners (i.e., screws, bolts) instead of rivets. All ballasts to be fully compatible with their respective lamp(s).

B. Minimum Starting Temperature: Colder than the coldest normal ambient temperature (minimum of minus 20°F).

C. Fluorescent Ballasts: Electronic type THD<20%. Acceptable Manufacturers: Advance "Mark V"; EBT "SSB1"; Magnetek "TRIAD." Electromagnetic Ballasts, use only where noted, THD<20%.

D. Fluorescent Dimming Ballasts: Electronic type, high power factor, smooth and continuous dimming capability without flicker down to 1% light, must strike lamps at any light level without first flashing to full light, must be inaudible in a 27dB room ambient throughout dimming range, must be UL listed, Class P, in compliance with FCC Part 18, and meet ANSI C62.41 standards for surge protection. Acceptable Manufacturer: Lutron "Hi-Lume" Series, no substitutes.

E. High Intensity Discharge Ballasts: Constant wattage autotransformer (CWA) ballasts where available for the type HID lamp used, or types as scheduled and as recommended by the lighting fixture manufacturer. All HID ballasts for interior lighting fixtures to be totally encapsulated, extra quiet type.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide the required lamp(s) and ballast(s) for each lighting fixture.

3.2 LAMPS

A. General: Follow the manufacturer's recommendations for handling and installing lamps.

B. Replacement: Replace all burned out, defective, or inoperative lamps prior to Owner acceptance.

C. Spare Lamps: Furnish to the Owner a stock of spare lamps not less than 10% of the total quantity installed (minimum of two) for each type of lamp used on the project.

3.3 BALLASTS

A. General: Make all required connections.

B. Replacement: Replace all noisy, defective or inoperative ballasts, starters, ignitors and miscellaneous accessories prior to Owner's acceptance.

C. Spare Ballasts: Furnish to the Owner a stock of spare ballasts not less than 10% of the total quantity installed (minimum of two) for each type of ballast used on project.

END OF SECTION 265110

SECTION 265600 (OPS) - EXTERIOR LIGHTING (OFF-SITE PUMP STATION NO. 2)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior luminaires with lamps and ballasts.
2. Luminaire-mounted photoelectric relays.
3. Poles and accessories.

B. Related Sections:

1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. HID: High-intensity discharge.

D. LER: Luminaire efficacy rating.

E. Luminaire: Complete lighting fixture, including ballast housing if provided.

F. Pole: Luminaire support structure, including tower used for large area illumination.

G. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4-M.

B. Live Load: Single load of 500 lbf (2224 N), distributed as stated in AASHTO LTS-4-M.

C. Ice Load: Load of 3 lbf/sq. ft. (145 Pa), applied as stated in AASHTO LTS-4-M Ice Load Map.

D. Wind Load: Pressure of wind on pole and luminaire and banners and banner arms, calculated and applied as stated in AASHTO LTS-4-M.

1. Basic wind speed for calculating wind load for poles 50 feet (15 m) high or less is 100 mph (45 m/s).

a. Wind Importance Factor: 1.0.
b. Minimum Design Life: 25 years.
c. Velocity Conversion Factors: 1.0.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816, Article 1.20-1.05.02 and NOTICE TO CONTRACTOR - SUBMITTALS

B. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
   a. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Photoelectric relays.
7. Ballasts, including energy-efficiency data.
8. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
9. Materials, dimensions, and finishes of poles.
10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
11. Anchor bolts for poles.
12. Manufactured pole foundations.

C. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

D. Field quality-control reports.

E. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.

F. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For luminaries and poles to include in emergency, operation, and maintenance manuals, specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with IEEE C2, "National Electrical Safety Code."

E. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

C. Verify available warranties and warranty periods for units and components and insert number below.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: One for every 100 of each type and rating installed. Furnish at least one of each type.
2. Glass and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Ballasts: One for every 100 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

1. LER Tests Incandescent Fixtures: Where LER is specified, test according to NEMA LE 5A.
2. LER Tests Fluorescent Fixtures: Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
3. LER Tests HID Fixtures: Where LER is specified, test according to NEMA LE 5B.

B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

a. Color: As selected from manufacturer's standard catalog of colors and as specified on the plans.

N. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

a. "USES ONLY" and include specific lamp type.
b. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
d. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
f. CCT and CRI for all luminaires.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

2.4 BALLASTS FOR HID LAMPS

A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features unless otherwise indicated:

1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.

2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C).
3. Normal Ambient Operating Temperature: 104 deg F (40 deg C).
4. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.

2.5 HID LAMPS

A. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65, and CCT color temperature 4000 K.

B. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and CCT color temperature 4000 K.

C. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and CCT color temperature 4000 K.

2.6 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

A. Structural Characteristics: Comply with AASHTO LTS-4-M.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.
2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
3. Anchor-Bolt Template: Plywood or steel.

D. Handhole: Oval-shaped, with minimum clear opening of 2-1/2 by 5 inches (65 by 130 mm), with cover secured by stainless-steel captive screws.

E. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."

2.7 STEEL POLES

A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig (317 MPa); one-piece construction up to 40 feet (12 m) in height with access handhole in pole wall.

1. Shape: As specified on the plans.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

B. Steel Mast Arms: Truss type, continuously welded to pole attachment plate. Material and finish same as pole.

C. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Adapter fitting welded to pole, allowing the bracket to be bolted to the pole mounted adapter, then bolted together with stainless-steel bolts.
2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.
3. Match pole material and finish.

D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

E. Steps: Fixed steel, with nonslip treads, positioned for 15-inch (381-mm) vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet (3 m) above finished grade.

F. Intermediate Handhole and Cable Support: Weathertight, 3-by-5-inch (76-by-127-mm) handhole located at midpoint of pole with cover for access to internal welded attachment lug for electric cable support grip.

G. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

H. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.

I. Platform for Lamp and Ballast Servicing: Factory fabricated of steel with finish matching that of pole.

J. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

K. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.

L. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind

welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."

2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

    a. Color: As selected by Architect from manufacturer's full range.

2.8 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

3.2 POLE INSTALLATION

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on Drawings:

1. Fire Hydrants and Storm Drainage Piping: 60 inches (1520 mm).
2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet (3 m).
3. Trees: 15 feet (5 m) from tree trunk.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."

D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.

1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
2. Grout void between pole base and foundation. Use non-shrink or expanding concrete grout firmly packed to fill space.
3. Install base covers unless otherwise indicated.
4. Use a short piece of 1/2-inch- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch- (150-mm-) wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch (25 mm) below top of concrete slab.

F. Raise and set poles using web fabric slings (not chain or cable).

3.3 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundations.

3.5 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):

   a. IESNA LM-5, "Photometric Measurements of Area and Sports Lighting Installations."
   b. IESNA LM-50, "Photometric Measurements of Roadway Lighting Installations."
   c. IESNA LM-52, "Photometric Measurements of Roadway Sign Installations."
   d. IESNA LM-64, "Photometric Measurements of Parking Areas."
   e. IESNA LM-72, "Directional Positioning of Photometric Data."

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265600 (OPS)

SECTION 265600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Comply with Division 1 - General Requirements, as well as Division 1 High Performance Buildings Requirements, Section 018113.13.

1. Section 265100 "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

2. Division 1, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(e)13.

a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all Electrical work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Section Includes:

1. Exterior luminaires with lamps and ballasts.
2. Luminaire-mounted photoelectric relays.
3. Poles and accessories.
4. Luminaire lowering devices.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. HID: High-intensity discharge.

D. LER: Luminaire efficacy rating.

E. Luminaire: Complete lighting fixture, including ballast housing if provided.

F. Pole: Luminaire support structure, including tower used for large area illumination.

G. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4-M.

B. Live Load: Single load of 500 lbf (2224 N), distributed as stated in AASHTO LTS-4-M.

C. Ice Load: Load of 3 lbf/sq. ft. (145 Pa), applied as stated in AASHTO LTS-4-M Ice Load Map.

D. Wind Load: Pressure of wind on pole and luminaire and banners and banner arms, calculated and applied as stated in AASHTO LTS-4-M.

1. Basic wind speed for calculating wind load for poles exceeding 49.2 feet (15 m) in height is 100 mph (45 m/s).

a. Wind Importance Factor: 1.0.
b. Minimum Design Life: 50 years.
c. Velocity Conversion Factors: 1.0.

2. Basic wind speed for calculating wind load for poles 50 feet (15 m) high or less is 100 mph (45 m/s).

a. Wind Importance Factor: 1.0.
b. Minimum Design Life: 25 years.
c. Velocity Conversion Factors: 1.0.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.

2. Details of attaching luminaires and accessories.

3. Details of installation and construction.

4. Luminaire materials.

5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

a. Testing Agency Certified Data: For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

b. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Photoelectric relays.

7. Ballasts, including energy-efficiency data.

8. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.

9. Materials, dimensions, and finishes of poles.

10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.

11. Anchor bolts for poles.

12. Manufactured pole foundations.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Anchor-bolt templates keyed to specific poles and certified by manufacturer.

3. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.

4. Wiring Diagrams: For power, signal, and control wiring.

D. Samples: For products designated for sample submission in the Exterior Lighting Device Schedule. Each Sample shall include lamps and ballasts.

1.6 INFORMATIONAL SUBMITTALS

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a professional engineer.

B. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Exterior Lighting to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Exterior Lighting as specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS and or as specified below.

C. Extra Materials:

1. Lamps: One for every 10 of each type and rating installed. Furnish at least one of each type.

2. Glass and Plastic Lenses, Covers, and Other Optical Parts: One for every 10 of each type and rating installed. Furnish at least one of each type.

3. Ballasts: One for every 10 of each type and rating installed. Furnish at least one of each type.

4. Globes and Guards: One for every 10 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with IEEE C2, "National Electrical Safety Code."

E. Comply with NFPA 70.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.

2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.

3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

4. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

1. LER Tests Incandescent Fixtures: Where LER is specified, test according to NEMA LE 5A.

2. LER Tests Fluorescent Fixtures: Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

3. LER Tests HID Fixtures: Where LER is specified, test according to NEMA LE 5B.

B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds

and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."

2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

a. Color: As selected from manufacturer's standard catalog of colors.
b. Color: Match Architect's sample of [**manufacturer's standard**] [**custom**] color.
c. Color: As selected by Architect from manufacturer's full range.

N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.

3. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

a. Color: Coordinate with architect.

O. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

a. "USES ONLY" and include specific lamp type.

b. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.

c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.

d. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.

e. ANSI ballast type (M98, M57, etc.) for HID luminaires.

f. CCT and CRI for all luminaires.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15-second

minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.

1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

2.4 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

A. Structural Characteristics: Comply with AASHTO LTS-4-M.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.

2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.

2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

3. Anchor-Bolt Template: Plywood or steel.

D. Handhole: Oval-shaped, with minimum clear opening of 2-1/2 by 5 inches (65 by 130 mm), with cover secured by stainless-steel captive screws

E. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.

F. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4-M.

2.5 ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B 429/B 429M, Alloy 6063-T6 with access handhole in pole wall.

B. Poles: ASTM B 209 (ASTM B 209M), 5052-H34 marine sheet alloy with access handhole in pole wall.

1. Shape: Round, straight.

2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

D. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

E. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.

1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
2. Finish: Same as pole.

F. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

G. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.

3. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

4. Finish

a. Color: As selected by Architect from manufacturer's full range.

2.6 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

B. Transformer Type Base: Same material and color as pole. Coordinate dimensions to suit pole's base flange and accept indicated accessories.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

3.2 POLE INSTALLATION

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on Drawings:

1. Fire Hydrants and Storm Drainage Piping: 60 inches (1520 mm).
2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet (3 m)

C. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.

1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.

2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.

3. Install base covers unless otherwise indicated.

4. Use a short piece of 1/2-inch- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

D. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch- (150-mm-) wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch (25 mm) below top of concrete slab.

E. Raise and set poles using web fabric slings (not chain or cable).

3.3 BOLLARD LUMINAIRE INSTALLATION

A. Align units for optimum directional alignment of light distribution.

B. Install on concrete base with top 4 inches (100 mm) above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

A. Install on concrete base with top 4 inches (100 mm) above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.5 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 GROUNDING

A. Ground metal poles and support structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.

2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.7 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):

a. IESNA LM-5, "Photometric Measurements of Area and Sports Lighting Installations."

b. IESNA LM-50, "Photometric Measurements of Roadway Lighting Installations."

c. IESNA LM-52, "Photometric Measurements of Roadway Sign Installations."

d. IESNA LM-64, "Photometric Measurements of Parking Areas."

e. IESNA LM-72, "Directional Positioning of Photometric Data."

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265600

SECTION 270533 TELECOMMUNICATIONS RACEWAY SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-4(b)7

1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all HVAC work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Description of Work: Provide a raceway and outlet box system suitable for the installation of telecommunications system(s) wiring.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.4 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For raceway to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For raceway specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide an empty raceway and outlet box system complying with 260533.

B. Conduit Sizes: Minimum 1" size, except that conduits to wall telephone outlets may be 3/4" size. Provide larger sizes as indicated.

C. Outlet Boxes: Minimum 4" square by 2-1/2” deep. Provide single-gauge extension ring for each

flush-mounted outlet box.

2.2 TELECOMMUNICATIONS TERMINAL BOARDS

A. New exterior grade plywood, 3/4" thick, 4' wide by 8' high, primed and painted with flame retardant white or gray paint.

2.3 COVERPLATES, JACKS, WIRING AND INSTRUMENTS

A. As indicated on the Contract Documents.

PART 3 - EXECUTION

3.1 GENERAL

A. Install raceway and outlet box system as indicated, complying with 260533, with not more than three quarter bends (270 degrees, total) between accessible pulling locations in conduit raceway. Ream and bush all conduit ends.

3.2 CONDUIT SIZES AND AMOUNT

A. Provide conduits as indicated on the Drawings. Terminate conduits at telecommunications terminal boards, outlets or as indicated.

B. Where a telecommunication outlet is shown on the Drawings without a connecting conduit, provide a conduit from the outlet box stubbed up to the nearest readily accessible ceiling space.

3.3 GROUNDING

A. Bond all metal conduits of the telecommunication system to the main telephone terminal ground point with minimum #12 AWG bare grounding conductors.

3.4 PULL WIRES

A. Install a pull wire in each conduit.

END OF SECTION 270533

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-4(b)7

1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all ELECTRICAL work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

1.3 SUMMARY

A. Section Includes:

1. UTP cabling.
2. 62.5/125-micrometer, optical fiber cabling.
3. Coaxial cable.
4. Multiuser telecommunications outlet assemblies.
5. Cable connecting hardware, patch panels, and cross-connects.
6. Telecommunications outlet/connectors.
7. Cabling system identification products.
8. Cable management system.

B. BICSI: Building Industry Consulting Service International.

C. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

D. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

E. EMI: Electromagnetic interference.

F. IDC: Insulation displacement connector.

G. LAN: Local area network.

H. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.

I. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

J. RCDD: Registered Communications Distribution Designer.

K. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. For coaxial cable, include the following installation data for each type used:

a. Nominal OD.
b. Minimum bending radius.
c. Maximum pulling tension.

C. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.

2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.

3. Cabling administration drawings and printouts.

4. Wiring diagrams to show typical wiring schematics, including the following:

a. Cross-connects.
b. Patch panels.
c. Patch cords.

5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

D. Samples: For workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration and faceplates for color selection and evaluation of technical features.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer**,** qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Cabling to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Cabling manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

C. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.8 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Patch-Panel Units: Ten of each type.
2. Connecting Blocks: Ten of each type.
3. Device Plates: Ten of each type.
4. Multiuser Telecommunications Outlet Assemblies: Ten of each type.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings**,** Cabling Administration Drawings, and field testing program development by an RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical loss test set.

2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.

3. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.

2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.

3. Bridged taps and splices shall not be installed in the horizontal cabling.

4. Splitters shall not be installed as part of the optical fiber cabling.

B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the telecommunications outlet/connectors to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: **25** or less.

2. Smoke-Developed Index: **50** or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Grounding: Comply with J-STD-607-A.

2.3 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated**,** 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm).

2.4 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Belden Inc.
2. CommScope, Inc.
3. Mohawk; a division of Belden Networking, Inc.

B. Description: 100-ohm, four-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.

2. Comply with TIA/EIA-568-B.1 for performance specifications.

3. Comply with TIA/EIA-568-B.2, Category 6.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, General Purpose: Type CM or CMG.
b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
c. Communications, Riser Rated: Type CMR, complying with UL 1666.
d. Communications, Limited Purpose: Type CMX.
e. Multipurpose: Type MP or MPG.
f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.5 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Belden Inc.
2. Leviton Commercial Networks Division.
3. Panduit Corp.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made, four-pair cables in 48-inch1200-mm lengths; terminated with eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.

2. Patch cords shall have color-coded boots for circuit identification.

2.6 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Belden Inc.
2. CommScope, Inc.
3. Mohawk; a division of Belden Networking, Inc.

B. Description: Multimode, 62.5/125-micrometer, 12 -fiber, tight buffer, optical fiber cable.

1. Comply with ICEA S-83-596 for mechanical properties.

2. Comply with TIA/EIA-568-B.3 for performance specifications.

3. Comply with TIA-492AAAB/TIA-492AAAA-A for detailed specifications.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

a. General Purpose, Nonconductive: Type OFN or OFNG.
b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
d. General Purpose, Conductive: Type OFC or OFCG.
e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.

5. Conductive cable shall be aluminum armored type.

6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.

7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

C. Jacket:

1. Jacket Color: Orange for 62.5/125-micrometer cable.

2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.

3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.7 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Belden Inc.
2. Berk-Tek; a Nexans company.
3. Corning Cable Systems.

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.

D. Cable Connecting Hardware:

1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B, TIA-604-3-B, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.

2. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 dB.

3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.8 COAXIAL CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alpha Wire Company.
2. Belden Inc.
3. CommScope, Inc.

B. Cable Characteristics: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.

C. RG-11/U: NFPA 70, Type CATV.

1. No. 14 AWG, solid, copper-covered steel conductor.

2. Gas-injected, foam-PE insulation.

3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.

4. Jacketed with sunlight-resistant, black PVC or PE.

5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.

D. RG-6/U: NFPA 70, Type CATV or CM.

1. No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
3. Jacketed with black PVC or PE.
4. Suitable for indoor installations.

E. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:

1. CATV Cable: Type CATV].
2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
3. CATV Riser Rated: Type CATVR, complying with UL 1666.
4. CATV Limited Rating: Type CATVX.

2.9 COAXIAL CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Emerson Network Power Connectivity Solutions.
2. Leviton Commercial Networks Division.
3. Siemon Co. (The).

B. Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.10 CONSOLIDATION POINTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Hubbell Premise Wiring.
2. Ortronics, Inc.; a subsidiary of Legrand Group.
3. Panduit Corp.

B. Description: Consolidation points shall comply with requirements for cable connecting hardware.

1. Number of Terminals per Field: One for each conductor in assigned cables.

2. Number of Connectors per Field:

a. One for each four-pair UTP cable indicated.

b. One for each four-pair conductor group of indicated cables, plus [25] percent spare positions.

3. Mounting: Recessed in ceiling.

4. NRTL listed as complying with UL 50 and UL 1863.

5. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.11 MULTIUSER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

Belden Inc
1. Hubbell Premise Wiring.
2. Ortronics, Inc.; a subsidiary of Legrand Group.
3. Panduit Corp.

B. Description: MUTOAs shall meet the requirements for cable connecting hardware.

1. Number of Terminals per Field: One for each conductor in assigned cables.

2. Number of Connectors per Field:

a. One for each four-pair UTP cable indicated.

b. One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.

3. Mounting: Recessed in ceiling.

4. NRTL listed as complying with UL 50 and UL 1863.

5. Label shall include maximum length of work area cords, based on TIA/EIA-568-B.1.

6. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

2.12 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

B. Workstation Outlets: Two-port-connector assemblies mounted in multigang faceplate.

1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."

2. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."

3. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.

a. Flush mounting jacks, positioning the cord at a 45-degree angle.

4. Legend: Machine printed, in the field, using adhesive-tape label.

2.13 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with J-STD-607-A.

2.14 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Section 260553 "Identification for Electrical Systems."

2.15 CABLE MANAGEMENT SYSTEM

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. iTRACS Corporation, Inc.
2. TelSoft Solutions.
3. Legrand Wiremold Inc.

B. Description: Computer-based cable management system, with integrated database and graphic capabilities.

C. Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.

D. Information shall be presented in database view technical drawings.

1. AutoCAD drawing software shall be used as drawing and schematic plans software.

E. System shall interface with the following testing and recording devices:

1. Direct upload tests from circuit testing instrument into the personal computer.
2. Direct download circuit labeling into labeling printer.

2.16 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-B.3.

E. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

F. Cable will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters. Conceal pathways and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

2. Install lacing bars and distribution spools.

3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.

2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."

3. Install 110-style IDC termination hardware unless otherwise indicated.

4. MUTOA shall not be used as a cross-connect point.

5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:

a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.

b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.

6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.

10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

12. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.

13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.

2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.

2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

G. Group connecting hardware for cables into separate logical fields.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: No requirement.

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.4 FIRESTOPPING

A. Comply with TIA-569-B, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 " Electrical Identification.

1. Administration Class: 1, 2, 3, or 4.

2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.

C. Comply with manufacturers requirements for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for each level of administration.

E. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables**,** terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

G. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.

3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).

4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.

b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.

H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.

2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.

3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. Optical Fiber Cable Tests:

   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

   b. Link End-to-End Attenuation Tests:

      1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA-526-14-A, Method B, One Reference Jumper.

      2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

6. UTP Performance Tests:

   a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:

      1) Wire map.
      2) Length (physical vs. electrical, and length requirements).
      3) Insertion loss.
      4) Near-end crosstalk (NEXT) loss.
      5) Power sum near-end crosstalk (PSNEXT) loss.
      6) Equal-level far-end crosstalk (ELFEXT).
      7) Power sum equal-level far-end crosstalk (PSELFEXT).

8) Return loss.
9) Propagation delay.
10) Delay skew.

7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.

8. Coaxial Cable Tests: Conduct tests according to manufacturers recommendations.

9. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.

a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.

b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.8 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for one year.

B. Upgrade Service: Update software to latest version at after one year of system final acceptance.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration software.

END OF SECTION 271500

SECTION 273000 TELEPHONE SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)5, 16a-38k-4(b)7

1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for all HVAC work. The administrative and procedural requirements included in this Section are to expand the requirements specified elsewhere.

B. Provide all equipment, programming services, set-up, installation and training and labor necessary to install a new telephone system. System features, capabilities and requirements as indicated in this specification and as indicated on contract documents.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

2. Submit layout drawings of telephone systems and accessories including, but not necessarily limited to, service- entrance penetrations, plywood mounting panels, apparatus, racks, terminals, and switching equipment.

3. Submit analog and digital data transmission wiring diagrams for telephone systems, including rack and terminal connections. Also show wiring connections to electrical power feeders. Differentiate between portions of wiring that are manufacturer-installed and portions that are field-installed.

1.4 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Telephone System to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Telephone System manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of telephone systems and ancillary equipment, of types, ratings and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms with at least 5 years of successful installation experience with projects utilizing telephone systems and equipment similar to that required for this project.

C. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC, including 800-Series articles as applicable to installation, and construction of telephone systems.

2. FCC Compliance: Comply with Part 68 and Subpart J of Part 15, Federal Communications Commission Rules, pertaining to telephone equipment and Class A computer registration by manufacturer.

a. Provide telephone and computer equipment with FCC labels indicating applicable FCC registration and numbering.

3. IEEE Compliance: Comply with Std 241, "IEEE Recommended Practice for Electric Power Systems in Commercial Buildings" pertaining to communication systems.

4. NEMA Compliance: Comply with NEMA's Pub No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)."

5. REA Compliance: Comply with Rural Electrification Administration specifications pertaining to construction and installation of telephone cabling.

6. EIA Compliance: Comply with EIA Standards RS-453, 455, and 464 pertaining to installation of telephone systems.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver telephone equipment and components in factory-fabricated containers or wrappings, which properly protect equipment from damage.

B. Store telephone equipment and components in original packaging. Store inside in a well-ventilated space protected from weather, moisture, soiling, humidity, and extreme temperatures.

C. Handle telephone equipment and components carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

1.8 SEQUENCING AND SCHEDULING

A. Installer shall notify local telephone operating company in writing of telephone interface connection requirements to ensure proper and timely interfacing of building telecommunication systems with the telephone operating company's systems.

B. Coordinate with other electrical work including wires/cables, electrical boxes and fittings, and raceways, to properly interface installation of telephone system with other work.

C. Sequence installation of telephone system with other work to minimize possibility of damage and soiling during remainder of construction.

1.9 MAINTENANCE

A. Agreement to Maintain: Engage Installer who is willing to execute with Owner the required agreement for continued maintenance of the telephone system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering telephone system equipment which may be incorporated in the work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide telephone system equipment of one of the following (for each type and capacity of equipment):

1. Mitel Corporation.
2. NEC America, Inc.
3. Rolm Corporation.

2.2 TELEPHONE SYSTEMS

A. General: Except as otherwise indicated, provide telephone systems with voice-quality lines, of types, styles, sizes and capacities indicated, which comply with manufacturer's standard design, materials, and components. Construct system in accordance with published product information, and as required for complete installation. Where types are not indicated, provide products complying with Rules of FCC, and established industry standards. Provide telephone system components with the following construction and functional features as listed in this specification.

B. Telephone Sets: For typical handset provide a quantity of 100 telephone sets, with full display and full duplex speakerphone with at least 24 programmable feature buttons with BLF capability. For reception handset provide 1 telephone set with side console for main answering point with at least 110 Button capacity. Provide 1 proprietary system cordless phone with speaker capability and display and at least 150' range.

C. Telephone System: Telephone System shall have the following features or capabilities:

1. Transferring.
2. Voicemail to Email for all users.
3. Intercoming/Paging from every telephone set.
4. Mobility for all users (Must include licensing to allow all users on the system to make cell phones or home phone extensions on the system).
5. On demand recording capabilities for all users.
6. Programmed button to record the telephone call that the end user is on which would then be saved into a voicemail box at the termination of the call.
7. Messaging Notifier – Voicemail must be able to notify a user remotely when a voicemail has been left throught the process of going off hook and calling the outside persons number to let them know they have a message.
8. Speed Dial capabilities system wide and per user.

9. Call logging at the phone set level –Tracking of calls made per user incoming and outgoing.
10. Redial.
11. Caller ID.
12. Must have the capability for the system to support DID's.
13. Parking Feature.
14. System must allow Dept. voicemail boxes to be separate of individual boxes.
15. Group Pickup
16. Remote access to voicemail.
17. Ability for employees to check voicemails for other employees.
18. Conference calling capabilities for at least 5 outside parties.
19. System must be able to grow at least 50% without the need for upgrading to the next system level.

D. System equipment: All equipment to support up to 124 telephone sets without need for additional equipment. System shall utilize an IP based deployment. Provide the following telephone equipment:

1. (1) PRI/TI card to support PR1 handoff from carrier.
2. (4) analog trunk ports.
3. (8) analog station ports.
4. (8) ports of voicemail with no less than 100 hours of storage capacity.
5. Battery back-up/surge protector device with no less than 90 minutes run time.
6. (1) music on hold player, which plays music when caller is placed on hold.

E. Programming and Timing:

1. Include all Labor needed to meet with and gather appropriate programming information in the effort to assist the town in developing a customized Auto-Attendant, as well as proper labeling and programming of telephone sets.

2. Include all labor to train ALL town end users, as well as provide administrative training for at least 2 Town administrative persons for the ability to make future programming changes.

F. Administration and Management:

1. Provide a web based GUI interface that will allow the Connecticut DOT to make necessary daily programming changes.

2. Include all labor to train at least 2 Connecticut DOT admin persons for the ability to make future programming changes.

G. Paging: Telephone system proposed must integrate with paging amplifier for connection to paging speakers.

H. Electrical Cable and Cable Connectors: Provide twisted-pair copper electrical cable, and cable connectors, in sizes and types indicated, and as recommended by telephone equipment manufacturer for indicated applications. Mate and match connector materials to factory-installed equipment connectors.

I. Telephone Accessories: Provide telephone accessories, including modular wall and floor jacks, junction boxes, connecting blocks and pre-wired boxes as indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which telephone systems are to be installed. Notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF TELEPHONE SYSTEMS

A. Install telephone systems as indicated, in accordance with manufacturer's written instructions and with recognized industry practices; ensure systems comply with installation and operational requirements of EIA, NEC and the Federal Communications, Commission.

B. Interface building telephone system with the operating telephone company's network, after the installation work has been completed.

C. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B, and the National Electrical Code.

3.3 GROUNDING

A. Provide equipment grounding connections for telephone systems as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.4 ADJUSTING AND CLEANING

A. Clean telephone equipment and components of dirt and construction debris upon completion of installation.

B. Touch-up scratched or marred enclosure surfaces to match original finishes.

C. Protect installed equipment and components from damage during remainder of construction period.

3.5 DEMONSTRATION

A. Upon completion of installation of telephone systems, and after telephone wire circuitry has been energized, demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with testing. Demonstrate to Owner that requirements for basic output signal levels, and values for attenuation and signal-to-noise ratios, have been achieved.

3.6 PERSONNEL TRAINING

A. Train Owner's personnel, as designated by Owner, in operation and maintenance of the telephone system. Provide minimum of 5 days of on-site in-service training by the manufacturer, or their representative.

3.7 WARRANTY REQUIREMENTS

A. 1 year warranty on all parts.

B. 1 year warranty on all labor.

C. 1 year of software updates and upgrades.

D. Provide pricing for yearly maintenance after year 1 which includes:
   1. Telephone support.
   2. Software assurance (inclusion of all software updates and upgrades).
   3. Hardware support (100% HARDWARE COVERAGE)
   4. Labor support (Includes all labor).

END OF SECTION 273000

SECTION 281300 ACCESS CONTROL

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4, 16a-38k-4(b)5, 16a-38k-4(b)7

1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.2 SUMMARY

A. This section includes the required access control equipment which includes but is not limited to software, control panels, door controllers, power supplies, card readers, door hardware, door contacts, request to exits, network equipment and software.

1.3 REFERENCES (MOST CURRENT EDITIONS OF THE FOLLOWING)

A. NFPA 70 (National Fire Protection Association) - National Electrical Code

B. NFPA (National Fire Protection Association) 262 – Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces

C. IEEE (Institute of Electrical and Electronics Engineers) C62.41 – Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

D. FM (Factory Mutual) Global – Class 4991 – FM Approval Standard of Firestop Contractors

E. FCIA (Firestop Contractors International Association) – Manual of Practice

F. UL (Underwriters Laboratories, Inc.) 294 – Standard for Access Control System Units

G. UL (Underwriters Laboratories, Inc.) 305 – Standard for Panic Hardware

H. UL Qualified Contractor Program for Firestop Systems and Spray-Applied Fire Resistive Materials (SFRM's)

1.4 PROJECT SCOPE

A. Provide all of the access control equipment and required software called out in this specification and shown on the project drawings. This project consists of but is not limited to the install and setup of all the necessary controllers, network switches, power supplies, card readers, door contacts, request to exits, camera alarm integration, etc..

1.5 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data Sheet for all equipment installed as part of this contract.

C. Shop Drawings:

1. Diagrams for cable management system.

2. See Editing Instruction No. 5 in the Evaluations for discussion of graphic standards for Drawings.

3. System labeling schedules.

4. Detail wiring diagrams, to include a detailed system one-line along with detailed device wiring.

5. Cable administration drawings.

6. Battery and charger calculations for central station, workstations, and controllers.

1.6 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

B. Security Vendor to submit proof of state licensure for installation of Security Systems.

C. Security Vendor to submit proof of installer certification for all equipment to be installed on project. This includes, but is not limited to all security equipment and Network switches.

D. Security Vendor to produce proof of install of three (3) similar jobs that meet the following requirements:

1. Previous install must employ Power Over Ethernet (PoE).
2. Previous install must include one of the three software systems listed , specifically OnGuard 2010 with OnGuard Video integration.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Access Control System to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Access Control manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

C. Copies of all software and associated licenses.

D. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.

E. System installation and setup guides with data forms to plan and record options and setup decisions.

F. Comprehensive database of all installed equipments characteristics and assigned IP addresses.

G. Project Record Documents: Record actual locations of video surveillance system, devices, terminal cabinets, riser conduit runs, and pertinent junction boxes on contract drawings. All project record documents shall be submitted to the Owner's representative for final review prior to the commissioning of the video surveillance system. It is absolutely imperative that record drawings be highly accurate due to the of the system's sensitive nature.

H. Training documentation: Include all training support literature, reference material and documented training attendance list.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Vendor: Vendor must have factory certified trained technicians completing all work onsite. The vendor's technicians completing the system startup and programming must be Microsoft Certified on Windows, Server 2003, and Server 2008. The vendor's technicians completing the network setup must be a network switch trained. The vendor must have a full service office located within 150 miles of the site.

C. Installer (Electrical Contractor): Master licensed electrician with documented experience of the installation of building network video surveillance systems.

D. All contractor, installer, and vendor personnel employed to work on this project shall be American citizens. Proof of citizenship shall be provided prior to the start of construction. All contractor, installer, and vendor personnel employed to work on this project that will be operating on site shall go through necessary background checks.

1.9 MAINTENANCE SERVICE

A. Execution Requirements: Furnish service and maintenance of the system components for one year from the Date of Substantial Completion. This shall include all recommended and required preventative maintenance inspections/testing as outlined by the manufacturer and repairs to manufacturer or installer defects. This service agreement includes all software upgrades, updates, and newest version releases. If new version of software is released during the construction of warranty period, it shall be installed and the existing system settings migrated at no cost to the owner. If the current software is discontinued and a new version with a new name is produced, the Contractor will provide this upgrade at no additional cost. Contractor at the completion of work shall submit to the Owner and Owner's Representative a schedule indicating when inspections/testing will be conducted and an outline indicating what inspections/testing will be conducted on the system during the course of the warranty period. All of this shall be provided with no charge to the Owner.

B. Also to be completed as part of the warranty service is the following:

1. Occupancy Adjustments: Within one year of Date of Substantial Completion, provide on-site assistance in adjusting devices and sensitivities to suit actual occupied conditions. Provide up to five visits to the site for this purpose.

C. All system service calls during the warranty period shall be handled in the following manner:

1. Owner shall contact the Electrical Contractor and initiate a service call who in turn shall contact the equipment vendor to respond and investigate the source of the service call.

2. If the equipment vendor establishes that the source of the service call is related to the electrical installation, the equipment vendor shall contact the Electrical Contractor for warranty service.

3. The Owner shall not be responsible for any charges during the warranty period that result in the Owner notifying the installing contractor of a defect in the system.

4. A qualified individual must respond to the service/warranty call within one hour with a phone response and be onsite within four hours of the time the service/warranty call was placed. Any response that exceeds this time limit will be considered a breach of contract. An unqualified individual responding to the service call does not meet the requirements of the warranty response time, and will be considered a breach of contract.

1.10 MAINTENANCE MATERIALS

A. Provide two (2) controllers of each type.

B. Provide four (4) readers of each type.

C. Provide four (4) door contacts of each type.

D. Provide two (2) patch panel of each type.

E. Provide two (2 PoE network switch of each type.

F. Provide one (1) Uninterruptible Power Supply of each type.

G. Provide one (1) server that meets the technical specifications of the largest server installed.

H. Provide one (1) Access Card printer cleaning kit per manufacturer's recommendations

I. Provide ten (10) Access Card Printer ribbon for future printing after construction is complete

J. Provide two hundred fifty (250) laminate sleeves with owner's hologram for future card generation

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements. Provide one of the following manufacturers:

1. Lenel. (This system manufacturer and features should be used as the basis of design.)
2. Amag.
3. Software House.

2.2 SYSTEM REQUIREMENTS

A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads.

Include surge protection for external wiring of each conductor's entry connection to components.

B. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."

1. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Listed and labeled by a qualified testing agency for compliance with NFPA 731.

2.3 SYSTEM DESCRIPTION

A. Security Management Software (SMS) Software Capabilities: Support an unlimited number of card readers, input points, video cameras, intrusion detection points, and relay outputs. The SMS database server shall support an unlimited number of cardholders, visitors, and assets limited only by the available memory on the ISC. The database server shall also support an unlimited number of system events and System Operator transactions in the history file limited only by available hard disk space. Client Workstations shall be limited only by the limitations of the operating system server software.

B. Provide software upgrade to the most recent version of provided system including all patches, versions, and changes for this specific facility. All software licensing shall be provided by the vendor, to include but not limited to door controllers, client machines, device mapping, system integration, camera alarm linking, etc.

1. Owner designated cameras shall be programmed to respond to access control system events to automatically capture when designated doors/gates are “forced” open, held open, invalid card read, or their card readers are actuated.

2. All door alarms are to report to software and signal the appropriate authority.

3. All door alarms are to annunciate on the facility map graphic to be setup by the Contractor.

a. Door Icon to Flash Red for alarm.
b. Provide Scale and Number of floor plans required.

4. All door held open times are to follow the owner’s established procedure based on door type. Contractor is to review all door held open times with owner prior to install and setup.

5. All doors are to be programmed to function fully in off-line mode if communication to the server is unavailable. All alarms that occur during the offline mode will trigger the programmed door controller action and report the alarm to the server once communication is restored. No alarm function will be repeated once alarm is reported to the server, the alarm is for record purposes only after an offline alarm event.

6. The vendor is review all alarm integration and alarm reporting with the owner prior to install and programming.

C. Provide all required programming of switches, routers, and servers to accommodate the VLANs listed below:

1. VLAN 1 – Video Surveillance
2. VLAN 2 – Electronic Access Control

2.4 SMS COMPONENTS

A. Provide network door controllers and associated components outlined in this section, as shown on the project plans. The network door controllers shall provide access control processing, host functioning and power for single/double door configurations. This includes the reader, lock, door status, request-to-exit device, and auxiliary devices. It shall provide full distributed processing of all access control functions. The unit shall provide fully functional off line operation when not actively communicating with the host access control software application; performing all access decisions and event logging. Upon connection with the host access control software application, the network door controller or network controller/reader shall upload all buffered off-line transactions to the host software

B. Intelligent System Controller (ISC)

1. Features:

a. Microprocessor-based, digital technology.

b. Distributed intelligence architecture, with controllers operating independently of one another.

c. All database information stored at the controller level.

d. All decision-making performed at the controller, eliminating degraded mode operation.

e. ROM (field) that can be upgraded from AC/FMS server.

f. Capable of receiving program instructions from the AC/FMS server, maintaining its program and executing decisions at the local door level.

2. Capacity:

a. (ICS) shall support two downstream RS-485 2-wire ports that can be used to connect up to 64 devices (64 doors) in many combinations.

b. Each controller supports 15MB of available on-board, non-volatile flash memory.

c. Battery-backed, non-volatile storage of 50,000 events.

C. Dual Reader Interface Module

1. 12 or 24 VDC power supply
2. Supports Data1/Data0, Clock/Data and -compatible RS-485 readers and keypads
3. Downloadable firmware
4. Six Form-C 5 A at 30 VDC relay outputs

5. Up to 16 different formats (8 card formats and 8 asset formats)
6. Issue code support for magnetic and Wiegand formats
7. Door contact supervision (open/closed)
8. REX push-button monitor
9. Strike control output
10. Bicolor reader status LED support and 2-wire LED support
11. Beeper control
12. Dedicated tamper and power failure circuits
13. Support for offline reader access mode
14. On-board jumpers for termination
15. On-board regulator allows 12 VDC reader support from 24 VDC power source
16. DIP switch-selectable addressing
17. Operating Temperature: 32º to 158º F, Operating Humidity: 0-95% RHNC
18. UL 294 and 1076-listed, CE marked, RoHS compliant
19. Make and model: Lenel LNL-1320 Series 2

2.5 CARD ACCESS READERS

A. Card Access Reader. Mount to single gang plates with tamperproof screws.

1. 10-28.5 vdc Operation
2. Operating temperature –22° –150ºF
3. 5.0” x 5.0” x 1.0” (12.7 x 12.7 x 2.54 cm)
4. Maximum read range up to 8” (20.5 cm)
5. Weigand output
6. Polycarbonate UL 294

B. Mullion Mount card reader. (MP)

1. 6.0” x 1.7” x 1.0” (15 x 4.5 x 2.0 cm)
2. 5-16 vdc operating range.
3. Maximum read range up to 5.5” (14.0 cm).
4. Weigand output.
5. Polycarbonate UL 294.

C. Vehicle entrance Card Reader

1. 11.8” x 11.8” x 1.0” (30.0 x 30.0 x 2.54 cm)
2. 12 or 24vdc
3. Maximum read rance up to 6’ (1.8m)
4. Weigand interface
5. Provide window mounted access device for reader. (quantity to be determined by representative)

2.6 ACCESS CARD PRINTER

A. Provide an access card printer where called for on the contract drawings that meet the following requirements.

1. High-speed printing-over 164 cards per hour
2. RFID ready/write ready
3. HID Prox and iClass modules available
4. Order iClass module for installation

5. Full color, edge-to-edge printing
6. 300dpi dye-submission printing technology. 24-bit continuous printing
7. 16.7 million colors
8. Dual sided printing
9. Dual sided lamination
10. Quick change ribbon cassette
11. USB 2.0
12. MTBF: 100,000 prints
13. Fully Windows compatible driver
14. Password protected driver
15. Variable UV printing
16. 2 year return to depot service printer warranty and 2 year unlimited prints print head warranty
17. UL1950, UL 1950-1993, CE class B, FCC A and B
18. Provide ribbons and all associated required printer supplies to print access cards for 2000 card holders.

2.7 ACCESS CARD LAMINATOR

A. Provide an access card laminator that attaches to the access card printer where called for on the contract drawings that meet the following requirements.

1. Single sided hardcoat patch, clear or holographic
2. Single sided softcoat, edge-to-edge holographic
3. Heat roller laminator that couples with access card printer to complete one machine
4. Full 1 mil thickness (hardcoat)
5. 0.25 mil thickness (softcoat)
6. Registered and non-registered (wallpaper)
7. Clear and custom holographic
8. Order iClass module for installation
9. Provide lamination material for 2000 access cards
10. Provide holographic image, based on owner's approval, for 2000 access cards

2.8 ACCESS CARD DIGITAL CAMERA WITH STAND

A. Provide an access card digital camera where called for on the contract drawings that meet the following requirements.

1. 2 megapixel progressive scan sensor
2. WDM, TWAIN, DirectX compatible
3. Still image capture with streaming video
4. Autofocus, 10x optical zoom
5. Software development kit available
6. 800 TVL resolution
7. Provide ¼" – 20 mounting block (#70V0423-B)
8. Provide 10' USB 2.0 cable (#60C1012)
9. Provide 12VDC power supply (#60PR12DC5.0A-AFZ)
10. Provide USA plug (#60C0021)

2.9 ACCESS CONTROL SERVER

A. Provide access control servers as called for on the contract drawings that meet the following requirements.

1. Quad-Core Processors
2. Intel Xeon Processor X5570 (2.93GHz, 8MB L3 Cache, 95W, DDR-1333, HT, Turbo 2/2/3/3)
3. Processor Cache: 8MB (1 x 8MB) Level 2 cache
4. 2.93 Processor speed
5. Memory type: PC#-8500R DDR3 RDIMM, operating at 1066 MHz
6. Maximum Memory 144 GB RDIMM
7. Storage type: Hot plug 3.5 inch SAS/SATA
8. Maximum number of hard drive: 24
9. HP Smart Array P410i Controller
10. Rack height: 4U
11. Warranty: 3 year parts, labor, and onsite
12. Provide redundant power supply
13. Provide redundant cooling fans

2.10 COMPUTER MONITOR (24”)

A. Provide a computer monitor where called for on the contract drawings that meet the following requirements.

1. Full High Definition 1920 x 1080 Resolution
2. 3D Digital Comb filter with Deinterlacing for High Quality Video
3. High Contrast Ratio
4. Lightweight Design
5. Built for 24/7 conditions
6. VGA, DVI, S-Video, BNC, and HDMI
7. Deinterlace Motion
8. Picture-in-Picture
9. Anti-glare Panel Surface
10. Energy Star Level Surface
11. 1000:1 contrast ratio
12. LED backlight type
13. 1920 x 1080 resolution at 60Hz
14. 16:9 aspect ratio, 16.7 million colors, PIP
15. 3 year warranty

2.11 RECESSED MOUNT POSITION SENSOR (DOOR CONTACTS)

A. Provide door contacts where called for on the contract drawings that meet the following requirements.

1. Self locking mounting
2. Rugged construction
3. 15/16” diameter
4. UL approved for specific fire doors
5. ABS Plastic construction
6. Response time: 1 msec max.
7. Life Cycles: 100,000 under full load, 10,000,000 under dry circuit
8. Lead types #22 wire
9. UL listed
10. Make and model: General Electric 1078 series or approved equal

2.12 NETWORK SWITCH (8 PORT) (1 FOR EACH COMM ROOM AND RADIO ROOM)

A. Provide power over Ethernet (PoE) network switches where called for on the contract drawings that meet the following requirement:

1. 8 RJ-45 auto-sensing 10/100 PoE ports (IEEE 802.3 Type 10Base-T, IEEE 802.3u Type 100Base-TX, IEEE 802.3af PoE); Media Type: AutoMDIX; Duplex: half or full

2. 2 dual personality ports; each port can be used as either an RJ-45 10/100/1000 port or and SFP slot

3. Layer 2/3 switching capabilities

4. One RJ-45 serial console port.

5. Freescale PowerPC 8313 @ 333MHz, 32MB flash, 128 MB DDR2 SDRAM, packet buffer size: 512KB dynamically allocatd

6. Mounts on an EIA standard 19 inch rack.

7. Total PoE Power 86W.

8. 3-year, 4-hour onsite 13x5 coverage for hardware (U4683E)

2.13 NETWORK SWITCH (FIBER OPTIC) (1 FOR EACH COMM ROOM AND RADIO ROOM)

A. Provide network switches where called for on the contract drawings that meet the following requirement:

1. 24 open mini-GBIC (SFP) slots, support as a maximum of 4 10-GbE ports, with optional module
2. Freescale PowerPC 8540 @666 MHz, 4MB flash, 256 MB DDR SDRAM
3. Mounts on an EIA standard 19 inch rack.
4. 1000 Mb Latency: < 3.7 µs (FIFO 64-byte packets)
5. 10Gbps Latency: < 2.1 µs (FIFO 64-byte packets)
6. Throughput: up to 75.7 million pps
7. Routing/switching capacity: 101.8 Gbps
8. Switch fabric speed: 105.6 Gbps
9. Routing table size: 10,000 entries
10. Distribution layer
11. Low-cost mini-GBIC connectivity, 10-GbE uplinks
12. Layer 2 to 4 and intelligent edge feature set

2.14 NETWORK PATCH PANEL

A. Provide a CAT6 Patch Panel, 24 Port, 1U per the contract drawings that meet the following specifications.

1. Meets CAT6 TIA/EIA-568-B.2-1 specs.
2. Features RJ-45 jacks on the front and IDC-110 contracts on the rear.
3. Durability rating for the IDC contacts is 200 termination cycles.
4. The insertion life is rated for 700 mating cycles with FCC compliant RJ-45 plugs.
5. Fits standard 19” racks.
6. UL Listed.

2.15 UNINTERRUPTABLE POWER SUPPLIES (UPS)

A. Provide Uninterruptable Power Supplies per contract drawings that meet the following specifications:

1. Output Power Capacity: 1980W/ 2200VA, 2100W/3000VA, 3500W/5000VA
2. Max Configurable Power: 1980W/ 2200VA, 2100W/3000VA, 3500W/5000VA
3. Nominal Output Voltage: 120V
4. Efficiency at Full Load: 95%, 88%, 91% respectively
5. Nominal Input Voltage: 120V
6. Input Frequency : 50/60 Hz +/- 3 Hz (auto sensing)
7. Input Connections: NEMA L5-20P, NEMA L5-30P, NEMA L6-30P respectively
8. Cord Length: 8 ft, 8 ft, 10 ft respectively
9. Input voltage range for main operations: 82-144V, 90-150V, 160-280V respectively
10. Input voltage adjustable range for mains operation: 75-154V, N/A, 240V respectively
11. Provide rack mount brackets for complete rack installation
12. Backup Time Required: 90 Minutes

2.16 RACK POWER DISTRIBUTION UNIT

A. Provide Rack Power Distribution Unit per contract drawings that meet the following specifications:

1. Input: 100v, 120V
2. Input Current: 20A
3. Cord Length: 12 feet
4. Output: 120V
5. Output Connections: Ten (10) NEMA 5-20R, Twenty-four (24) NEMA 5-20R
6. Provide rack mountable brackets for complete rack installation
7. cUL Recognized, UL 1363
8. Warranty: 2 years repair or replace
9. RoHS compliant

2.17 ACCESS CARDS

A. Cards shall be provided with the following style, technology, and quantity.

1. Proximity credit card size and shape, 125 kHz 26 bit format

2. Each card shall bear a hot stamped or printed number on its surface. The system matches the card number against the internal numbers (no cross-referencing).

3. It shall be possible to fasten adhesive photo IDs to the surface of credit-card size proximity cards.

4. The PIN number associated with each card shall not be obtainable by direct manipulation of the internal encoded number.

5. Each card, in addition to the randomly encoded number, shall also contain a 'facility' or 'batch' code. It shall be possible for the system to utilize this facility code in either of two methods: general or site specific. When site specific processing is enabled, this facility code shall be checked by the ACU and access will be denied to any card that does not belong to this project.

6. Provide facility and batch code in sequential order to the facility and batch codes. Coordination with owner is required.

7. Cards that require predefined 'issue levels' shall not be acceptable.

8. The system shall be capable of recognizing one card at multiple locations.

9. The system shall have the ability to read cards with multi-bit formats concurrently.

10. Vendor is to consult with owner prior to ordering to make sure the proper card numbering sequence, facility code, and card type is ordered.

11. Provide 2,000 cards, sealable ID holders, and lanyards/badge reels.

2.18 ACCESS CONTROL POWER SUPPLIES

A. For Door Locking Equipment (PMX): Shall include the following: 6 amp 12/24 VDC power supplies, batteries and battery chargers:

B. For Power to Controller (PDX): Shall include the following: Amp 12/24 vdc single output power supplies, batteries and battery chargers.

2.19 WIRE AND CABLE

A. Product Description: Power limited cable, copper conductor; 300 volts insulation rated (24 degrees C).

B. Refer to contract drawings for wire types and sizes

C. Refer to Specification 271500 for exact details of wire type and parameters.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Splice cable only in accessible junction boxes or terminal cabinets. No splices shall be made in wiring between terminal points. Terminations shall be made within secure (alarmed) enclosures. Low voltage cabling shall be installed in separate raceway than any circuitry carrying a voltage of 120vac or greater.

B. The Contractor shall obtain all necessary permits and have all necessary electrical inspections conducted in conformance with state and local regulations. All electrical work shall be inspected by the Authority Having Jurisdiction.

C. Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.

D. The security access system Vendor under direction of the Owner, shall program the entire security access system. This shall include entering all card holder information and the setting up of card holder access accounts. Programming shall also include setting up Owner specified auxiliary functions such as camera capture, time delays, etc. A meeting shall be held a minimum of four (4) weeks prior to final acceptance of the system to discuss Owner operations and programming requirements. Those in attendance shall be the Owner,

Contractor, Vendor, and Owner's Representative. The system shall be fully programmed prior to system acceptance testing and training.

E. The security system program shall incorporate VLAN's programmed at the owner's/manufacturer's instruction. VLAN1 – Access Control data, VLAN2 – CCTV data, VLAN3 – Intrusion Detection, VLAN4 – DOH IT monitoring channel utilized to monitor the status of the switches, servers, and various components.

3.2 FIELD QUALITY CONTROL

A. Testing

1. Preliminary Tests: Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed device.

2. Final Acceptance: The system will be accepted only after satisfactory test of the entire system has been accomplished by a factory-trained distributor, in the presence of the Authority Having Jurisdiction, the Owner, and the Owner's Representative. The Vendor shall notify the above witnesses, in writing, 72 hours prior to the commencement of testing.

3. The Vendor shall provide the on-site services of an authorized technical representative of the manufacturer to supervise all connections and fully test all components of the system installed. The Vendor, as directed by the Owner, shall conduct the acceptance test. The system shall be tested with the minimum required tests as follows:

a. Verify the absence of unwanted voltages between circuit conductors and ground.

b. Test all conductors for short circuits using an insulation-testing device.

c. With each circuit pair, short circuit at the far end and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on the record drawings.

d. Verify that the control panel is in normal condition.

e. Test each peripheral device for proper signal transmission.

f. Test entire system for proper operation and response at the control unit.

g. Test both primary and secondary power supplies.

h. Operation of each control, alarm, and monitoring point in the system and integration with other building systems.

i. Simulate loss of communications between each controller and the host computer.

j. Report generation.

k. Every Cat6 cabling link in the installation shall be tested in accordance with the field test specifications defined in ANSI/TIA/EIA-568-C "Transmission

Performance Specifications for 4-pair 100Ω Category 6 Cabling", which is outlined in contract specification 271700, Testing and Identification.

4. The Vendor shall provide test sheets to document all tests. These will be signed by all present to verify testing is complete

5. If any part of the test fails to meet the performance of the Contract Documents, the Vendor and or Electrician, at their own expense, shall retest the complete system with all applicable parties present.

6. Prior to the final testing, the Vendor shall perform tests on all systems to insure proper operation.

3.3 DEMONSTRATION AND TRAINING

A. The Vendor shall provide a minimum of four (4) 4 hour sessions of instruction and operation, maintenance and programming of all elements of the security access system.

B. Instruction shall be provided by a material or system manufacturer's certified representative familiar with the equipment and special operating requirements of the system provided and the Owner's operating procedures.

C. Instructions shall include classroom training as well as hands on training of all user level programming and system operation.

D. Instruction shall be made available on a schedule acceptable to the Owner and the availability of the operating personnel. Instructions shall be in two separate groupings with the last instruction time frame 30 days after the second grouping. This is to allow the operating personnel to familiarize themselves with the equipment and get follow-up training as required. The last training session shall be a minimum of 4 hour(s).

E. The Vendor shall be responsible for providing sufficient training materials for all present at the training session, (minimum 15 personnel). Coordinate actual requirements with the Owner at time of training.

F. The Vendor shall be responsible for providing videotaped training sessions, which will be submitted to the owner for future employee training. The video shall be submitted to the owner is a digital format via USB or DVD.

G. Training shall be conducted upon completion of construction at each individual site and prior to beginning work on the next.

END OF SECTION 281300

SECTION 282304 INDOOR AND OUTDOOR SURVEILLANCE CCTV SYSTEM

PART 1 GENERAL

1.1 DEFINITIONS

A. Provide: Furnish and install, complete and ready for the intended use. Deliver to the project site all required equipment and accessories, install and interconnect all required equipment and accessories for a complete and operational CCTV system.

B. Approved: Acceptable to the Owner's Representative and the Engineer.

C. Furnish: Supply and deliver to project site, ready for unloading, unpacking, assembly, installation, and similar operations.

D. Install: Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

E. Manufacturers' Technical Advisor:

1. An employee of the company producing the system (or a company which lists and markets the primary components of the system under their name) who is certified in writing by the company to be technically qualified in design, installation, and servicing of the required products. Personnel involved solely in sales do not qualify.

F. Integrator's Field Advisor:

1. An individual employed by an organization (other than the company producing the system), certified in writing by the company producing the system, that the individual is technically qualified in design, installation and servicing of the required products and is capable to act as a field advisor in their behalf. Personnel involved solely in sales do not qualify.

1.2 RELATED DOCUMENT

A. Division 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(b)4 , 16a-38k-4(b)5, 16a-38k-4(b)7

1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed

1.3 SYSTEM DESCRIPTION

A. Network-based Video Security System (NVSS) which includes power supplies, network storage managers, system manager, PC work stations, keyboard control units, network switch, video console display, universal device interface, and monitors

B. System shall permit the normal and event monitoring of all secured areas on composite or LED Monitors shown on drawings. Video Monitoring Consoles shall be installed at the main security console room and the main security equipment room.

C. Video monitoring of all cameras shall be possible at the control console. Review capabilities for the digitally recorded video via the secure network specified without interruption to recording capabilities.

D. Network Storage Manager (NSM) and storage expansion recorders shall be configured using fault-tolerant RAID-6 drive arrays. Network storage managers and storage expansion shall be sized as specified herein and in the quantities as shown on the drawings. All inputs will have the ability to record at 30 images per second, 4-CIF resolution. Data will be stored for a minimum of 9 days at 15 images per second, 4-CIF resolution and 9 days pruned and Data will be stored for a minimum of 18 days.

E. The IP networked video security system network shall be arranged so each area will operate independently and shall communicate via a 1000baseT (Giga-bit) network at a minimum to the System Manager. The system shall utilize virtual matrix switcher capabilities through the use of a System Manager. The System Manager shall provide a user interface and database management of the IP networked video security system. The System Manager shall allow for users to be restricted via software to logical configurable groups of cameras, monitors and system operations.

F. The System Manager shall be capable of performing as a Network Time Protocol (NTP) Server for the entire system. The IP networked video security system shall be synchronized to an NTP server so that all system components are on the same time clock basis. The NTP server shall reside within the system, and be capable of being driven by external time sources if needed. All time-zone corrections shall automatically be provided in the system.

G. The System Manager shall be capable of performing as a DHCP and UPnP server for the entire system and components. The System Manager shall provide all connection and management communications between system devices

H. The System Manager shall be capable of incorporating RSA 256 bit public/private key authentication in addition to custom bit public/private key's. The system shall be capable of authenticating any video produced by the encoder that originally produced the stream, Network Storage Manager (NSM) recording the stream, operator who exported the stream, all with time/date stamped video.

I. The System Manager shall manage rights and permissions for all devices, persons, and any system video or other data.

J. The IP networked video security system based digital recording and monitoring system shall incorporate a fault tolerant architecture and shall include redundancy in critical areas of concern. Encoder power supplies and NSM/storage box power supplies shall be capable of redundancy. In addition, all NSM's and storage boxes shall provide RAID 6 redundancy as a standard in case of any system failure.

K. The system shall provide an API/SDK that is capable of being used at a level that is consistent with a full-featured gateway. The gateway shall provide RS232 ASCII

interface, Ethernet interface, and the ability to create custom plug-ins to the system user interface.

L The system shall provide multi-level diagnostics of each component in all critical areas. These diagnostics shall be reported to a diagnostic console for processing. In addition, the diagnostic data shall be capable of being scripted into actionable events within the system.

M. The IP networked video security system shall be able to handle future expansion of an unlimited total capacity from what is shown in the drawings, including but not limited to cameras, monitors, alarm circuits and relay closures.

N. The following capabilities are considered essential for IP networked video security system described in this specification.

O. The IP Based IP networked video security system software shall provide a built-in Digital Video Virtual Matrix Switcher. The IP networked video security system shall support the ability to switch any camera in the system to any monitor in the system, either through a PC Keyboard/Mouse or a joystick controller to a LED Monitor.

P. All components of the system shall utilize a Windows based Operating System.

Q. The IP networked video security system shall be an integrated hardware and software platform. It shall provide distributed administration of multiple devices and administer rights and privileges for all attached devices.

R. The System Manager shall manage system security, functioning as a key manager for user and device authentication, and it shall route communication between all devices on large, sub-netted security networks. The system manager shall store and administer secure keys and shall have multi-level and user permission management.

S. The System Manager shall function as the default system time network storage manager, using the industry standard NTP protocol, to ensure integrated devices are synchronized. The system manager shall support UPNP architecture and shall provide DHCP services, supporting the dynamic addition of network devices.

T. The System Manager shall store a database of device errors, alarms, and other system events, and the comprehensive database shall be accessed and searched through the system log window. The system manager shall allow for connection to an intelligent uninterruptible power supply (UPS), and it shall allow for a message to be sent to the UPS in the case of a power failure. As an additional feature, the system manager supports data replication: a duplicate set of critical system data can be stored on a second System Manager, enabling quick and easy transition to IP Video Security equipment.

U. The IP networked video security system encoders, workstations, all cameras, monitors, alarms, relays, etc. shall be configurable.

V. Provide for unlimited system operators with personal identification numbers (PINs) with priority levels, operator facilities, system roles, and camera and monitor groupings

W. The IP networked video security system shall have the capability of the following functionalities:

1. The system shall be fully distributed in nature so that each system device can remain operational in a majority of modes without dependence on other devices. Each individual entry in a sequence shall have the capacity to trigger PTZ camera presets, patterns or auxiliaries.

2. Multiple users shall be able to view the same camera view or sequence simultaneously. The system shall utilize Multi-cast streaming video to allow multiple users to view the same video stream, though not necessarily synchronized with each other, without affecting the bandwidth of the network.

3. Video titling shall provide for a 100 character camera site description (on/off), display time / date (on/off), set the display color (black/white), display a site message (on/off) and define the screen block position for the title.

X. The IP networked video security system shall have the capability to create and execute a system script used to control any system function, and may be combined into any order. The configuration of such scripts shall be easy to use and follow the rules of drag and drop configuration. The following actions are minimal requirements:

1. Display video from any camera to a specific monitor or screen division, including changing screen division views.

2. Reset any monitor to its' original screen division and image.

3. Move system PTZ cameras to a specified preset location.

4. Activate predefined patterns on system PTZ cameras.

5. Start/stop recording an event from any indicated video source.

6. Utilize Script Nesting, a means of running another script within any given script.

7. Activate system relays and send e-mail notification to any recipient via pop3.

8. Add wait times to any script command.

9. The scripting language shall utilize a system function upload and will modify or send out a global command to all components in the system.

10. Operator control of a camera or selection of monitors shall override the sequence control of camera or monitor; sequence control of cameras or selection of monitors shall not override operator control of camera of selection of monitors.

11. The IP networked video security system shall allow for programming of alarms and associated incoming alarms with related parts of the system.

12. Individual, or group, or all of alarms shall be disabled by special sequences, which can be initiated by the operator or automatically by time/day/date.

13. The IP networked video security system shall log all alarms and events in the System Manager database.

14. The IP networked video security system shall provide real time system status on the operator GUI. For example, all alarms, present monitor activity, selected PTZ camera ID in user defined descriptive text.

Y. An attendant in the Control Room operates the NVSS and observes the monitors to survey and evaluate the status of personnel in the areas within range of the camera stations.

Z. Scenes are viewed by camera stations:

1. Pan/tilt/zoom camera stations contain equipment required for completely adjustable viewing of scenes (remotely controlled from keyboard control units).

2. Fixed camera stations contain equipment required for viewing a fixed scene (not remotely adjustable).

AA. The keyboard control units allow the attendant to control the following Work Station (WS) multiple-stream decoding unit functions:

1. Camera station functions including addressing, pan and tilt (joystick control) zoom, and focus. (Iris is automatically controlled, not manually controlled through WS).

2. Alarm closure arm and clear.

3. Camera station automatic sequencing run and hold.
   a. The programmed sequence may either be continuously repeated until the hold button is depressed or the sequence may be programmed to stop on a selected camera station until the run button is pushed.

4. Single "quick look" sequence.

5. Call up of pre-positioned scenes.

6. Call up of any camera station to any monitor connected to the output of the WS.

BB. The WS can be programmed by the system manager via the keyboard control units connected to the WS. The following features can be programmed by the system manager:

1. Automatic roll-free sequencing of camera stations in any order on monitors connected to the output of the WS.

2. Dwell time (2 to 60 seconds) that each camera station scene is displayed in sequence on the monitor.

3. Time and date.

4. On screen camera station identification (2 or 3 digit numeric plus up to 16 alphanumeric characters for each individual camera). The identification positioning and brightness is independently adjustable for each monitor.

5. A minimum of 20 pre-positioned scenes for each pan/tilt/zoom camera stations.

6. Camera call up.

7. Activate alarm.

8. Set alarm title.

CC. Access to the system functions are controlled thru at least 2 levels of access security to prevent program modifications or use by unauthorized personnel.

1. At the lowest level of access the keyboard programming functions are disabled. The attendant has minimum access to the system functions (camera switching and remote control).

2. At the highest level of access, programs may be modified by the system manager.

DD. When camera station signals are displayed on monitors connected to the output of the WS camera station identification, date, and time are also displayed.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Shop Drawings:

1. Composite wiring and/or schematic diagrams of the complete system as proposed to be installed (standard diagrams will not be accepted), including video signal integrity equipment, etc. required for a complete system.

2. Scale drawings showing mounting of camera station components.

3. Details of camera station poles and bases.

4. Scale drawings showing location and mounting of components to be mounted in the security equipment racks.

C. Product Data:

1. Catalog sheets, specifications and installation instructions.

2. Bill of materials.

3. Detailed description of system operation (format similar to SYSTEM DESCRIPTION).

4. State number of video inputs and outputs used specifically for this project and number of video inputs and outputs available for future use if system is expanded to maximum capacity.

5. Name, address and telephone number of nearest fully equipped service organization.

1.5 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1. Copy of license for installing Security Systems.

a. Also include copy of identification card issued by the Licensee for each person who will be performing the Work.

2. Design Data: Certified data from the manufacturer of the camera station poles proving that the deflection rate will not exceed the specified limits.

3. Installers' Qualifications Data: Include a completed INSTALLER'S QUALIFICATION DATA FORM for each person who will be performing the Work.

a. Forms must be completely filled out.

b. Forms must include all information required, showing that the experience criteria have been met.

c. Each Form must be signed by the installer.

4. Integrator’s Field Advisor Data: Include:

a. Name, business address and telephone number of Integrator’s Field Advisor secured for the required services.

b. Certified statement from the Company listing the qualifications of the Integrator’s Field Advisor.

c. Services and each product for which authorization is given by the Company, listed specifically for this project.

5. Letter from the Integrator’s Field Advisor stating that the Integrator’s Field Advisor has reviewed the Submittals Package for accuracy and completeness and approves all materials and installation methods included in the Submittals Package.

6. System Qualifications: Submit System Qualification information required by 1.05, A, if proposing a system other than that specified

B. Point to Point Wiring Diagrams:

1. Submit complete point to point wiring diagrams of the entire system as it is to be installed.

a. Point to Point wiring diagrams shall show the following:

1) All components in the system.

2) All cables and conductors between each component.

3) Identify all cables and conductors and show all terminations and splices (identification shall correspond to markers to be installed on each conductor).

b. Point to Point wiring diagrams shall have an accompanying letter from the Integrator’s Field Advisor(s) stating that the Integrator’s Field Advisor(s) has reviewed the Point to Point wiring diagrams for accuracy and completeness and approves the Point to Point wiring diagrams for use.

C. Contract Closeout Submittals:

1. Video tape test recordings (scenes).

2. System acceptance test report.

3. Certificate: Affidavit, signed by the Integrator’s Field Advisor(s) and notarized, certifying that the system meets the contract requirements and is operating properly.

4. Operation and Maintenance Data:

a. Deliver 2 copies, covering the installed products, to the Director's Representative. Include:

1) Operation and maintenance data for each product.

2) Complete point to point wiring diagrams (As-Built Drawings) of entire system as installed. Identify all conductors and show all terminations and splices (identification shall correspond to markers installed on each conductor).

3) Name, address, and telephone number of nearest fully equipped service organization.

1.6 QUALITY ASSURANCE

A. Equipment Qualifications:

1. Products other than those specified:

a. If products other than those specified, are proposed for use, furnish the name, address, and telephone number of at least 5 comparable installations that can prove the proposed products have operated satisfactorily for 1 year.

1) Reference information required above must be that of the End-User of the equipment, no other references will be accepted (i.e. Installers, Sales Rep's, etc.).

2) Pay travel expense for the Director's Representative to inspect two of these installations.

b. The Company producing the product shall have test facilities available, which can demonstrate that the proposed product meets contract requirements.

1) Pay all costs, including travel expenses to the test facility for the Director's Representative to witness test demonstration.

B. Installer's Qualifications: The persons installing the Work of this Section and their supervisor shall be personally experienced in closed circuit television systems and shall have been engaged in the installation of closed circuit television systems for a minimum of 3 years.

1. Qualifying experience must be in the installation of CCTV systems similar in operation and construction of the system being specified by this section.

2. Furnish to the Director completed INSTALLER'S QUALIFICATION DATA FORM for each person who will be performing the Work. Each form shall include:

a. Installer's name.

b. Employer's Name and Address.

c. Qualifying Experience: Project information of 5 similar projects, which the installer, had worked on during the past 3 years. Information shall include for each project:

1) Name and Address of project.

2) Dates installer worked on project.

3) Name and telephone Number of installer's supervisor for the project.

4) Types of security installation work installer performed on project.

C. Manufacturers' Technical Advisor: Secure the services of a Manufacturers' Technical Advisor from the Company producing the NVSS for the following:

1. Assist in the formation of the Submittals Packages, and review the Submittal Packages for accuracy and completeness.

3. Engineering associated with interconnections between the NVSS and the cameras.

4. Render advice regarding installation and final adjustment of the system.

5. Coordinate installation of the system and the related work with the other systems.

6. Conduct a pre-installation meeting at the contract site with the installers (and their supervisor) who will be performing the work, with the owner's representative. The meeting shall be a minimum of 8 hours in duration (held in four 2 hour increments). The topics covered shall include, but shall not be limited to the following:

a. Manufacturers' Technical Advisor shall present an overview of the system as it is to be installed.

b. Manufacturers' Technical Advisor shall lead a discussion of installation concerns and coordination issues on this system and related systems and related work being installed under this project.

c. Manufacturers' Technical Advisor shall provide training on procedures for installing system components and precautionary measures installers should be aware of while performing the work.

1) Manufacturers' Technical Advisor shall review point to point wiring diagrams with the installers and provide training on termination, bonding and grounding procedures required for proper installation of the system wiring and components.

7. Provide supervision of the installation at the contract site for a minimum of 60 hours and for the following:

a. Supervise the installation of the NVSS.

b. Render advice regarding installation and final adjustment of the system.

c. Coordinate installation of the system and the related work with the other systems.

d. Perform programming of the system.

e. Perform preliminary tests of the system.

f. Train facility security personnel, security supervisory personnel and maintenance personnel in operation and routine (weekly) testing of the system (minimum of four 3-hour sessions).

g. Train facility maintenance personnel in adjustments, programming, routine maintenance and annual testing of the system (minimum of 8 hours of training – held in four 2 hour increments).

h. Witness final system test and certify with an affidavit that the system is installed in accordance with the contract documents and is operating properly.

i. Explain available service programs to facility supervisory personnel for their consideration.

D. Manufacturers' Technical Advisor (Camera Stations): Secure the services of a Manufacturers' Technical Advisor from the Company producing the camera stations for the following:

1. Assist in the formation of the Submittals Packages, and review the Submittal Packages for accuracy and completeness.

2. Engineering associated with interconnections between the NVSS and camera stations.

3. Assist the Manufacturers' Technical Advisor of the NVSS with conducting the pre-installation meeting at the contract site. The Manufacturers' Technical Advisor for the camera stations shall conduct a portion of the pre-installation meeting. This portion of the meeting shall be a minimum of 2 hours in duration and cover the following topics (but shall not be limited to the following):

    a. Manufacturers' Technical Advisor for the camera stations shall present an overview of each type of camera station as they are to be installed.

    b. Manufacturers' Technical Advisor for the camera stations shall lead a discussion of installation concerns and coordination issues on the installation of the cameras stations with the NVSS.

    c. Manufacturers' Technical Advisor for the cameras shall provide training on procedures for installing the camera stations and precautionary measures installers should be aware of while performing the work.

        1) Manufacturers' Technical Advisor shall review point to point wiring diagrams with the installers and provide training on termination, bonding and grounding procedures required for proper installation of the system wiring and components.

4. Provide supervision of the installation at the contract site for a minimum of 8 hours and for the following:

    a. Supervise the installation of the camera stations.

    b. Render advice regarding installation of the cameras.

    c. Assist in initial and final adjustments to the cameras.

    d. Perform preliminary tests of the system.

    e. Train facility security personnel in operation, and routine (weekly) testing of the cameras (minimum of two 2-hour sessions).

    f. Train facility maintenance personnel in adjustments, routine maintenance and annual testing of the camera stations (minimum of 8 hours of training – held in four 2 hour increments).

    g. Assist in performing final system test and certify with an affidavit that the cameras are installed in accordance with the contract documents and are operating properly.

    h. Explain available service programs to facility supervisory personnel for their consideration.

1.7 MAINTENANCE

A. Service Availability: A fully equipped service organization capable of guaranteeing response time within 8 hours to service calls shall be available 24 hours a day, 7 days a week to service the completed system.

B. Spare Parts:

1. One complete outdoor PTZ camera station (camera, lens, receiver/driver, housing).
2. Two complete indoor camera station (camera, lens, housing).
3. 4% of total hand drive purchased.
4. Two fan kits for NSM/NVR.
5. One POE Switch
6. One SFP-6

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements. Provide one of the following manufacturers:

1. Pelco. (This system manufacturer and features should be used as the basis of design.)
2. Bosch.
3. Panasonic.

2.2 CCTV CONTROL AND MONITORING EQUIPMENT

A. Network-based Video Security System (NVSS)

1. System Manager: as manufactured by one of three listed manufacturers.

2. Keyboard Control Unit (KCU): keyboard, having:

a. All features necessary to perform the keyboard requirements outlined in the SYSTEM DESCRIPTION.

b. Compatible for use with their Work Station model WS-5070.

c. Accessories as required for locating keyboard remotely from WS.

3. Keyboard (KB): keyboard

4. Keyboard Video Mouse switch (KVM)

5. Ethernet Switch (ES) 10/100/1000.

6. Power Over Ethernet Switch (POE) 10/100/1000.

7. Work Station (WS): as manufactured by one of the three listed manufacturers.

8. Network Storage Manager (NSM): as manufactured by one of the three listed manufacturers.

B. Monitors: Flat Panel Display Monitor: TFT LCD having:

1. 19 inch diagonal screen size, unless otherwise noted on Drawings.

2. Over 500 lines of horizontal resolution.

3. Loop through video connections with switchable 75 ohm termination.

4. Front access controls.

5. Mounting accessories:

a. Movable Folding Mounting Arm: and extension as required.

C. Security Equipment Rack: fully welded steel frame, modular cabinet rack assembly having:

1. Number of sections as required to house the system equipment.

a. Each section 31 inches deep by 19 inches wide panel space, with height as indicated on drawings. Note: The number of sections indicated on the drawings are the minimum number to be provided. If additional sections are required due to the characteristics of the system equipment, provide additional sections as approved.

2. Skeletal frame including top and bottom.

a. Black e-coat finish and numbered rack spaces.

3. Front, Back, and Side Panels:

a. Fully vented locking front doors.

b. Blank panels to cover front panel space where equipment is not installed.

c. High CFM split rear door, 1320 CFM for 44 space.

d. Set of 4 leveling feet.

e. Solid top black e-coat finish.

1) Size as required to enclose equipment indicated on the drawings.

f. Black enamel finish.

4. Chassis support angles and equipment shelves:

a. Provide fixed shelves for support of equipment that is not rack mountable.

5. Accessories as required for mounting and support of equipment.

6. Surge Protection Multi-outlet strips mounted within the enclosure with number of 15 amp, 120V ac receptacles (3 wire grounding type) as required for equipment. (Not less than 6 receptacles in each section.)

D. Uninterruptable Power Supply (UPS):

1. On-line uninterrupted power supply, 2200VA/2.2Kva 2U rack mounted.

2. Simultaneous communications via HED compliant USB port, serial port, SNMP/Web card slot and EPO interface.

3. Fault tolerant auto-bypass mode, current monitoring and switched PDU control via 2 switchable output load banks.

4. Input: NEMA 5-20P (120V) / Output: 6 NEMA 5-15/20R and 1 NEMA L5-20R (120V).

5. 2 year product warranty / $250,000 Ultimate Lifetime Insurance.

6. (UPS-BAT) UPS Battery supply

2.3 FLAT-PANEL HIGH DEFINITION LCD MONITOR

A. The FHD LCD monitor shall the following features: VGA and digital visual interface (DVI) inputs, picture-in-picture (PIP), looping BNC output, and full high definition resolution.

B. The FHD LCD monitor shall provide a front panel that allows the user to adjust image quality, brightness, size, position, and geometry for optimal viewing.

C. The FHD LCD monitor shall have improved airflow and thermal reduction allowing for longer component life, ensuring reliability in a 24/7 security installation environment.

D. The FHD LCD monitor shall be constructed of a lightweight aluminum frame composition for desktop or wall-mount installations. Stationary and tilt wall mounts shall be available. The monitors shall provide built-in hand holds in the rear cover for easy installation and handling.

E. The FHD LCD monitor shall be compatible with industry-leading megapixel technology, providing a minimum of 1920 x 1080p native resolution that is used with the latest megapixel video security cameras.

F. The FHD LCD monitor shall meet or exceed the following design and performance specifications.

1. Electrical Specifications

a.	Input Voltage:	100 to 240 VAC, 50/60 Hz
b.	Power Consumption:	120 W
c.	Video Input Interfaces	
d.	2 BNC, looping;	1 S-Video, looping; 1 RGB; 1 DVI; 1 component
e.	Audio Input Interfaces	2 audio L/R, RCA jack
f.	Horizontal Frequency:	31 to 69 kHz
g.	Vertical Frequency	56 to 85 Hz
h.	Sync Format	NTSC/PAL

G. Environmental Specifications

1.	Operating Temperature	32° to 104°F (0° to 40°C)
2.	Operating Humidity	20% to 80%, noncondensing

H. Physical Specifications

1.	Dimensions (without stand):	3.0” D x 29.3” W x 17.3” H (7.67x74.52x43.94cm)
2.	Unit Weight:	66.1 lb (30.0 kg)

I. Mechanical Specifications

1.	Native Resolution	1920 x 1080p
2.	Panel Aspect Ratio	16:9
3.	Viewing Area	698.4 x 392.8 mm
4.	Pixel Pitch:	0.363 x 0.363 mm
5.	Video Formats	480p, 576p, 720p, 1080i, 1080p
6.	Brightness:	350 cd/m2
7.	Contrast Ratio:	3000:1
8.	Backlight Type:	CCFL
9.	Panel Life	50,000 hours
10.	Viewing Angle (H/V)	178°/178°
11.	Displayable Colors	16.7 million
12.	Response Time:	5 ms
13.	PIP	Selectable, sizeable, swappable, moveable
14.	Speakers	2 internal (5 W, 4 ohms x 2)
15.	Front Panel Controls	Menu, source, up/ down, power, and volume +/-
16.	Indicators	LED (power on/off)

J. Certifications:

1. CE, Class A
2. FCC, Class A
3. UL/cUL listed
4. C-Tick
5. S Mark for Argentina*
6. CCC

K. Warranty: 2 year, parts and labor

L. Model Numbers: 32-inch LCD monitor, 1920 X 1080p resolution

2.4 FLAT PANEL MOUNTS

A. The flat panel monitor shall be provided with a wall-mount suitable for the weight and size of the specified unit and provide swivel and/or tilt capabilities.

B. The flat panel monitor shall be provided with side-mounted speakers.

2.5 CAMERA STATIONS (INDOOR)

A. Type I-VFLL(A) (Indoor-Vari Focal Length Lens):

1. Fully-integrated enclosure with camera and lens:, having:

a. Factory installed fixed focal length lens, 1/3 inch format (focal length and aperture as indicated in camera station schedule on drawings).

b. Vandal resistant capability and tamper-resistant hardware.

c. Clear bubble.

d. Configuration suitable for wall or ceiling mounting as indicated on drawings.

e. Mounting accessories as required.

f. The network camera shall offer dual video streams with up to 0.5 megapixel resolution (800 x 600) in progressive scan format.

g. The network camera shall provide SureVision technology which includes extended Wide Dynamic Range (WDR), low-light performance, and anti-bloom technology.

h. The network camera shall use a true WDR sensor that takes multiple exposures at the pixel level and has a rating for WDR of 120dB.

i. The network camera shall provide line-in and line-out audio and built-in microphone.

j. The network camera shall support two simultaneous, configurable video streams. H.264 and MJPEG compression formats shall be available for primary and secondary streams with selectable Unicast and Multicast protocols. The streams shall be configurable in a variety of frame rats and bit rates.

k. The network camera shall support industry standard Power Over Ethernet (POE), Class 2 to supply power to the camera over the network.

l. The network camera shall use a standard Web browser interface for remote administration and configuration of camera parameters.

m. The network camera shall support standard IP protocols.

n. 2.8-10mm Vari-Focal megapixel lens.

B. Type I-VFLL (B) (Indoor-Vari Focal Length Lens)(Use for 100’ or over):

1. Fully integrated enclosure with camera lens for long corridors, having:

a. Factory installed fixed focal length lens, 1/3 inch format (focal length and aperature as indicated in camera station schedule on drawings).

b. Vandal resistant capability and tamper-resistant hardware.

c. Clear bubble.

d. Configuration suitable for wall or ceiling mounting as indicated on drawings.

e. Mounting accessories as required.

f. The network camera shall offer dual video streams with up to 0.5 megapixel resolution (800 x 600) in progressive scan format.

g. The network camera shall be capable of firmware upgrades through a network using a software-based device utility.

h. The network camera shall support two simultaneous, configurable video streams. H.264 and MJPEG compression formats shall be available for primary and secondary streams with selectable Unicast and multicast protocols. The streams shall be configurable in a variety of frame rates and bit rates.

i. The network camera shall support industry standard Power over Ethernet (PoE) to supply power to the camera over the network. The network camera shall also offer a 24 VAC power input for optional use.

j. The network camera shall use a standard Web browser interface for remote administration and configuration of camera parameters.

k. 15-50mm Vari-Focal megapixel lens.

2.6 CAMERA STATIONS (OUTDOOR PTZ)

A. Type O-HSCHA (Outdoor High Speed Camera/ Housing Assembly), Network Dome Positioning System, having:

1. Camera:

a. Color Format: Monochrome (Black & white) or combination Color/ Monochrome (Day/Night) CCD camera as indicated on drawings.

b. Image Format: 1/4 to 1/2 inch (as selected by camera manufacturer to meet low light sensitivity requirement).

c. Low light sensitivity: full video at .05 foot-candles scene illumination (clear housing lens, f/1.8 camera lens at 75% highlight reflectance).

d. Horizontal Resolution: Better than or equal to 500 TVL.

e. Line-Lock adjustment: Synchronizes camera to power line zero crossing for roll-free vertical interval switching.

f. The indoor/outdoor camera dome system shall provide a 100Base-TX network interface for live streaming to a standard Web browser.

g. The indoor/outdoor network positioning camera shall use a standard Web browser interface for remote administration and configuration of camera parameters. The browser interface shall provide PTZ control including preset and pattern and on-screen display (OSD) for access to camera programming.

2. Automatic Zoom Lens, having:

a. Size: 1/4 to 1/2 inch format (as selected by camera manufacturer to match camera requirements).

b. Adjustable (horizontal) field of view from approximately 48º (wide angle) to approximately 2.7º (telephoto).

c. Auto-iris.

d. Equipped for automatic pre-position call-up.

e. Aperture F-stop rating: Better than or equal to f/1.4.

3. Camera Housing, having:

a. Dome housing sized to house camera, lens, pan/tilt unit and receiver/driver unit.

b. Clear Housing lens.

c. Minus 40 degrees F to 122 degrees F temperature operating range.

1) Integral Heater and blower: Maintains internal temperature of housing within operating range of camera, lens, pan/tilt and receiver driver units, with an outside temperature of Minus 40 degrees F to 122 degrees F.

4. Pan/Tilt Unit, having:

a. Integrally mounted in the camera housing.

b. Pan Range: 0º to 360º continuous.

c. Tilt Range: -5º to 90º from horizontal plane.

d. Pan/Tilt Speeds:

1) Automatic call-up (pre-position) speed of 120º per second (or better).

2) Manual speed control coordinated with the lens, as follows:

a) Lens at full telephoto, the pan and tilt speeds will be reduced to prevent the operator from panning or tilting the camera faster than the operator can view the scene (approximately 3º per second).

b) Lens adjusted between full wide angle and telephoto, the pan and tilt speeds will be reduced to prevent the operator from panning or tilting the camera faster than the operator can view the scene (between 3º to 30º per second).

c) Lens at full wide angle, the operator shall be able to pan and tilt the camera at speed of approximately 30º per second or less depending operator's handling of the control system's joystick.

e. Pre-position option, with accuracy of ± 0.5º for pan and tilt.

5. Receiver/Driver Unit, having:

a. Integrally mounted in the camera housing.

b. Number of Pre-positions: 99 minimum.

c. Full compatibility with the encoder.

1) Receiver/Driver unit receives and decodes signals from the NVSS for control of camera station pan, tilt, lens and pre-position functions.

d. Internal address coding switches

6. Power Requirements: 24 Volts AC.

a. Provide 120V/24V transformer.

7. Mounting equipment: Provide all materials required to securely mount the Outdoor High Speed Camera/ Housing Assembly to the camera pole.

8. Accessories: Provide all materials and work, as required for the Outdoor High Speed Camera/ Housing Assembly to function as listed in items 1 thru 6 above and as indicated in the SYSTEM DESCRIPTION.

B. Type O-FFCHA (Outdoor Fixed Focal Camera/ Housing Assembly), Sorix Fixed Dome Camera, having:

1. Camera:

a. Color Format: Monochrome (Black & white) or combination Color/ Monochrome (Day/Night) CCD camera as indicated on drawings.

b. Image Format: 1/4 to 1/2 inch (as selected by camera manufacturer to meet low light sensitivity requirement).

c. The network camera shall provide advanced low-light capabilities for day/night models with sensitivity down to 0.12 lux in color and 0.03 lux in black-white.

d. Horizontal Resolution: Better than or equal to 500 TVL.

e. Line-Lock adjustment: Synchronizes camera to power line zero crossing for roll-free vertical interval switching.

2. Automatic Zoom Lens, having:

a. Size: 1/4 to 1/2 inch format (as selected by camera manufacturer to match camera requirements).

b. Adjustable (horizontal) field of view from approximately 48º (wide angle) to approximately 2.7º (telephoto).

c. Auto-iris.

d. Equipped for automatic pre-position call-up.

e. Aperture F-stop rating: Better than or equal to f/1.4.

f. 15-50 mm mega pixel lens unless otherwise noted on drawings.

3. Camera Housing, having:

a. Dome housing sized to house camera, lens and receiver/driver unit.

b. Clear Housing lens.

c. Minus 40 degrees F to 122 degrees F temperature operating range.

1) Integral Heater and blower: Maintains internal temperature of housing within operating range of camera, lens, with an outside temperature of Minus 40 degrees F to 122 degrees F.

4. Power Requirements: 24 Volts AC.

a. Provide 120V/24V transformer.

5. Mounting equipment: Provide all materials required to securely mount the Outdoor Fixed Camera/ Housing Assembly to the camera pole.

6. Accessories: Provide all materials and work, as required for the Outdoor Fixed Camera/ Housing Assembly to function as listed in items 1 thru 6 above and as indicated in the SYSTEM DESCRIPTION.

2.7 SURGE PROTECTION

A. Equip system with surge suppressors to protect equipment from voltage transients and lightning surges. Provide surge suppressors to protect each cable (and conductor) entering and leaving fence accessory stations, and the security equipment rack.

1. Internal surge protection built-in to system devices is not acceptable protection, provide external surge suppressor units.

2. The type of surge suppressor units to be provided shall be suitable for the circuit it is connected, as recommended by the surge suppressor manufacturer and approved for use by the Company Field Advisor(s) for the Indoor and outdoor CCTV System.

2.8 WIRING

A. Cables:

1. Exterior Cameras:

a. For Connections between the Ethernet Switch (ES) and Camera Stations, provide CAT6 suitable for direct burial. For connections between the camera Power Supply (PS) and camera stations, provide #16AWG, 2 conductor cables suitable for direct burial.

2. Interior Cameras:

a. For connection to Fixed Camera Stations located within the building, provide CAT 6 cable; Paige TIA/EIA certified category 6, unless otherwise recommended by camera manufacturers.

b. For connection to PTZ Camera Stations located within the building, provide CAT 6 cable; Paige TIA/EIA certified category 6, unless otherwise recommended by camera manufacturers.

3. Type TVB: Shielded twisted pair of #18 AWG conductors, with high density polyethylene jacket suitable for direct burial.

4. Miscellaneous Cables; provide additional cables as required for System to function as summarized in SYSTEM DESCRIPTION and indicated on the drawings:

a. Number, size, and type of conductors as recommended by the Company producing the equipment.

b. Conductors shall be enclosed in a cable with a jacket suitable for the environment that they are to be installed.

b. Conductors shall be enclosed in a cable with a jacket suitable for the environment that they to are be installed.

2.9 CONNECTORS

A. Connectors: As produced by Amphenol Corp. (Weatherproof type where installed in exterior locations.)

2.10 VIDEO SIGNAL INTEGRITY EQUIPMENT

A. Video amplifiers, differential amplifiers, ground loop eliminators, etc., as required for proper signal transmission to produce sharp, clear, distortion free pictures on monitors.

2.11 MARKERS AND NAMEPLATES

A. Markers:

1. Premarked self-adhesive.
2. Flexible sleeve markers.

3. Snap-on markers.
4. Thermal transfer (non-smearing).

B. Nameplates: Precision engrave letters and numbers with uniform margins, character size minimum 3/16 inch high.

1. Phenolic: Two color laminated engraver's stock, 1/16 inch minimum thickness, machine engraved to expose inner core color (white).

2. Materials for Outdoor Applications: As recommended by nameplate manufacturer to suit environmental conditions.

2.12 TEMPERATURE SENSOR

A. Temperature Sensor, High/Low temperature sensor with water..

1. Supervised Water Bug Surface Sensor
2. Remote Sensor Probe)

2.13 POWER SUPPLY

A. Power Supply (outdoor perimeter cameras) with the following features:.

1. 4 or 20 A capacities
2. 1-4 outputs
3. 120VAC input
4. 24VAC or 28VAC output for longer wire runs
5. NEMA 4X/IP66 standards weatherproof enclosure
6. AC power indicator with power on/off switch

2.14 ACCESSORIES

A. Include accessories required to perform the functions summarized in SYSTEM DESCRIPTION and indicated on the drawings.

2.15 NETWORK SWITCHES

A. Switching Mode Power Supply (SMPS):

1. The power supply shall be a switching mode power supply (SMPS)..

2. The SMPS shall take 90 to 264 VAC @ 47 to 63 Hz or 120 to 370 VDC as input voltage.

3. The SMPS shall produce a stable 48 to 53 VDC and be capable of supplying 5 amperes at 48 VDC (240 W).

4. Line regulation shall be within +/- 0.5%.

5. Ripple shall be no more than 150 mV, pk-pk.

6. The SMPS shall incorporate automatic power factor correction.

7. To minimize damage to a powered device (PD), the SMPS shall have output overvoltage protection to limit the maximum output voltage to 54 to 60 VDC.

8. The SMPS shall incorporate current limiters to provide output short circuit protection.

9. The SMPS shall be capable of being mounted to standard 7.5 or 15 mm DIN rail and shall be mounted such that its chassis is at least one inch on all sides from any other object to allow adequate cooling to occur.

10. Power Connections: Screw terminals (10 to 24 AWG wire)

B. 26-Port Fiber Optic Gigabit Ethernet Managed Switch with POE:

1. The Ethernet managed switch system shall support transmission utilizing Category 5 cable or better, multimode, or single-mode fiber. The module shall support the Ethernet data IEEE 802.3 protocol using Auto-negotiating and Auto-MDI/MDI-X features.

2. The module shall feature 24 (twenty four) 10/100TX RJ-45 ports with PoE and 2 (two) combo 10/100/1000TX RJ-45 ports / Gigabit SFP ports. Use of an SFP port disables the corresponding 10/100/1000TX RJ-45 port. Similarly, use of a 10/100/1000TX RJ-45 port disables the corresponding SFP port.

3. The module shall provide power, link speed, and fiber port status indicating LED's for monitoring proper system operation.

4. The module shall have redundant power supply connections to minimize single point failure.

5. The module shall have a lifetime warranty to reduce system life cycle cost in an event of a module failure.

6. Network redundancy.

7. Electrical Specifications:

i. Power:

1). 45VDC to 52VDC, 400 W maximum

ii. Current Protection: Automatic re-settable solid-state current limiters

iii. Voltage Regulation: Solid-state, Independent on each board

iv. Circuit Board: UL 94 flame rated and meets all IPC standards.

C. 24-Port Fiber Optic Gigabit Ethernet Layer 2 Managed Switch (ES):

1. The Ethernet managed switch shall support transmission utilizing Category 5 cable or better, multimode, or single-mode fiber. The Switch shall support IEEE 802.3 protocol using Auto-negotiating and Auto-MDI/MDI-X features. The switch shall feature three bays. Each bay shall be capable of accepting one of the following

modules: Modules shall be available with eight 10/100/1000 RJ-45 ports, eight 1000FX SFP ports, and four 10.100/1000 RJ-45 ports along with four4 1000FX SFP ports.

2. Network Redundancy.

3. Electrical Specifications:

   i. Power:

      1). AC 100 to 240 V or DC 12 V to 48 V.

   ii. Connection for redundant power shall be available.

4. The module shall have redundant power supply connections to maximize single point failure.

5. The module shall have a five-year warranty.

6. 3-slot gigabit module hot-swappable.

7. 8 pert 10/100/1000 Mbps Module, 4TX, 45FP connector a.(1) SFP-6 for each fiber input. 1000 fx, 1310nm, 15km, LC.

D. Ten Port Fiber Optic Gigabit Ethernet Managed Switch

1. The Ethernet managed switch system shall support transmission utilizing Category 5 cable or better, multimode, or single-mode fiber. The module shall support the Ethernet data IEEE 802.3 protocol using Auto-negotiating and Auto-MDI/MDI-X features. The module shall feature 7 7 (seven) 10/100TX RJ-45 ports, 3 (three) 10/100/1000TX RJ-45 ports, and 3 (three) Gigabit SFP ports.

2. The module shall have redundant power supply connections to minimize single point failure.

3. The module shall have a lifetime warranty to reduce system life cycle cost in an event of a module failure.

4. Data Specifications

   a) Data Interface: Ethernet IEEE802.3
   b) Data Rate: up to 1000 Mbps
   c) Data Inputs/Outputs: up to 10
   d) Operation Mode: Half or Full Duplex

5. Status Indicators
   a) Power: Proper Power = Green
   b) RJ-45 Link/Data: Green, No Link/No Data: Off
   c) SFP Link/Data: Green, No Link/No Data: Off

6. Electrical Specifications

a) Power: 12VDC to 24VDC @ 1A maximum
b) Current Protection: Automatic re-settable solid-state current limiters
c) Voltage Regulation: Solid-state, Independent on each board
d) Circuit Board: UL 94 flame rated and meets all IPC standards.

2.16 POWER OVER ETHERNET MIDSPAN DEVICES

A. Single Port midspan.

B. Connectors: Shielded RJ-45, EIA 568A and 568B

C. Output Power Voltage: 48Vdc

D. User Port Power: 15.4W max

E. Input power : 100 to 240 Vac

F. IEEE802.3af compliant

G. Pass through data rates: 10/100/1000 Mbps

PART 3 EXECUTION

3.1 INSTALLATION

A. Pre-installation Meeting.

1. After approval of Submittals Package 1, conduct Pre-Installation Meeting.

a. Provide a minimum of 1 week notice to the Director's Representative, so that a Pre- Installation meeting schedule can be set up with facility personnel, CDOT Representatives and arrangements can be made for a location to hold the meeting.

b. Provide all materials necessary for training (training aides, handouts, overhead projector, etc.).

B. Install closed circuit television system in accordance with the Company's printed instructions.

1. Terminations and connections to devices are not to be made until Point to Point Wiring Diagrams (required to be submitted in Submittals Package 2) have been submitted and approved.

C. Cables:

1. Optical Fiber cables shall be continuous and un-spliced between the security equipment racks and the camera stations.

a. Splices for connection to surge protection units in these cables shall be

allowed at the security equipment racks. Connections or splices will not be allowed at any other location in the system.

D. Connections:

1. Make connections and splices at camera stations. Connections at the security equipment racks. Connections or splices will not be allowed at any other location in the system.

2. Use markers to identify conductors at terminal strips and security equipment racks (designations shall correspond with point to point wiring diagrams).

a. Markers for individual conductors of a multi-conductor cable is not required, if the following requirements are met:

1) Each individual conductor in the cable is color coded differently from other conductors in the cable.

2) The multi-conductor cable has a marker identifying it.

3) The color coding of each conductor is identified on the point to point wiring diagram.

3. Use coaxial cable connectors for splicing and terminating coaxial cables. Use terminal strips for splicing and terminating other types of cable.

E. Surge Suppressers:

1. Provide surge protection on each CAT 6 cable power cable entering and leaving security equipment racks.

F. Nameplates:

1. Install nameplate at each camera station, indicating CS number:

a. For pole mounted/fence post mounted camera stations, install nameplate on pole at approximately 6 feet above finished grade.

2. Install nameplate stating monitor's designation number over each monitor that is connected to the output of the WS.

3.2 SYSTEM TRAINING

A. After the system is substantially complete and operational, provide on-site training of facility security, security supervisory, and maintenance personnel.

1. Provide a minimum of 1 week notice to the Director’s Representative, so that a training schedule can be set up with facility personnel and arrangements can be made for a location to hold the training..

2. Provide all materials necessary for training (training aides, handouts, overhead projector, etc.).

B. System Operation Training: Training shall be set-up so that at the end of training, facility (security, security supervisory, and maintenance) personnel shall have a complete understanding of:

1. How the system operates.

   a. Training should include precautionary concerns that personnel should be aware of that could effect proper operation of the system.

2. Knowledge of all components in the system and their function.

3. How the system is interconnected with other security systems and how the system operates in conjunction with the other systems.

4. Weekly testing procedures for the system required to be performed.

   a. Each perimeter zone shall be tested weekly as follows:

      1) Perform the detections system's weekly test as described by below.

         a) Check to see that the activation of the detection system in that zone (thru the perimeter alarm system) causes the following responses by the perimeter surveillance CCTV system:

            (1) Camera stations associated with the alarm points are automatically switched to the video quad and alarm monitor of the CCTV system and switched to the CCTV system's video recorder. The video recorder should automatically start recording upon alarm.

               (a) Prior to performing a test on a perimeter zone monitored by pan/tilt/zoom camera station, so to confirm proper functioning of the camera station, perform the following:

                  (i) Pan the camera station 90 degrees away from the zone that is to be tested.

                  (ii) Tilt the camera station to an angle other than what will be called up when the zone goes into alarm.

                  (iii) Adjust the lens' field of view to a setting other than what will be called up when the zone goes into alarm.

               (b) Verify pre-position (pre-shot) called-up upon alarm by each pan/tilt/zoom camera station is aimed and focused to completely view the zone in alarm.

(c) Verify that LED located adjacent to each dedicated monitor illuminates when the zone(s) that the monitor is associated with are in alarm.

(d) Verify video recorder activation by reviewing recorded images after performing weekly testing of automatic camera call-up upon alarm.

(i) Recorded images should show actions of each camera station upon receipt of the alarms.

(ii) Recorded images will provide record of test having been performed and will provide indication of the quality of the recording and ensure images being recorded are in satisfactory.

C. System Maintenance Training: Training shall be set-up so that at the end of training, facility maintenance personnel shall have a complete understanding of:

1. Routine (monthly, quarterly or annual) maintenance required to the system and how to perform that maintenance.

a. Training should include precautionary concerns that personnel should be aware of that could effect proper operation of the system.

2. Knowledge of all components in the system and adjustments to the components that they would be required to perform to maintain operation of the system.

3. Programming of the system.

a. Training should include, but is not limited to the following:

1) How to program automatic call-up of camera stations as salvos (and set camera station pre-positions) when the zones they are associated with go into alarm.

2) How to set pre-positioned scenes for each zoom-pan/tilt camera station.

3) How to program automatic sequencing of camera stations in any order on monitors connected to the output of the WS.

a) How to set dwell time (2 to 60 seconds) that each camera station scene is displayed in sequence on the monitor.

4) How to set system time and date.

5) How to program on screen camera station identification displayed for each camera.

a) How to set the identification positioning and brightness for each monitor connected to the output side of the WS.

6) How to store and re-store system programming to and from floppy disks, via the Systems Programming Computer.

7) Training should include instruction in all programming required to the system necessary for the system to operate as outlined in the SYSTEM DESCRIPTION.

8) Training should include precautionary concerns that personnel should be aware of that could effect proper operation of the system working on the system.

4. How to replace all items listed as spare parts for the system.

a. Training should include precautionary concerns that personnel should be aware of that could effect proper operation of the system working on the system.

5. Annual testing procedures for the system required to be performed by the Department.

a. The perimeter surveillance CCTV system shall be tested annually as follows:

1) Perform weekly test upon the system.

2) For pan/tilt/zoom camera stations: Verify all pre-positions settings for each camera station is aimed and focused as required.

3) Check the condition of all of the system monitors to ensure that each displays a clear and sharp picture.

4) Check system’s time/date setting.

5) Check operation system from each system keyboards and monitors connected to the system.

3.3 FIELD QUALITY CONTROL

A. Preliminary System Test:

1. Preparation: Have the Company Field Advisor adjust the completed system and then operate it long enough to assure that it is performing properly:

a. Adjust each camera's imaging device position ("Back Focus Adjustment") in relationship with its lens to maximize the camera performance. Make adjustments at night (or during the day using a filter). Iris shall be fully open while adjusting the position of the imaging device in the camera. Exact method for adjustments shall be in accordance with the camera and lens manufacturers' printed instructions.

b. Make adjustments for clear, sharp, distortion free scenes and roll-free vertical interval switching to the satisfaction of the Director's Representative.

c. Program system, including salvo call-up of camera stations upon alarm as indicated on the drawings and their pre-position programming of each camera station to view the zone in alarm.

1) Pre-position Tour: Pre-position No. 99 for each camera station shall be set so that with all camera stations set at pre-position No. 99 a complete tour of the facility's perimeter fences associated with the perimeter alarm system is made.

a) In pre-position No. 99, the entire perimeter shall be covered and automatic sequencing of cameras stations simulates a tour of the perimeter alarm system fence.

2. Run a preliminary test for the purpose of:

a. Determining whether the system is in suitable condition to conduct the acceptance test.

b. Checking and adjusting equipment.

c. Training facility personnel.

B. Video DVD Test Recordings (Scenes):

1. After completion of the preliminary system test and prior to system acceptance test, make video DVD recordings of the following scenes recorded from the cameras installed under this project:

a. During daylight with the cameras positioned in pre-position No. 99, consecutively sequence all cameras (with the dwell time set for each camera at 30 seconds) for a minimum period of 15 minutes or until all cameras have been viewed twice.

b. Same as item "a." above except recording shall be done at night.

2. Include written description to accompany tape to identify each recorded scene.

3. Video DVD recordings shall be suitable for playback on a standard DVD recording system.

4. Supply equipment necessary to make the video DVD recordings.

C. System Acceptance Test:

1. Prerequisite: Video DVD Test Recording of camera scenes must be approved prior to scheduling of the System Acceptance Test.

2. Preparation: Notify the Director's Representative at least 3 working days prior to the test so arrangements can be made to have a Facility Representative witness the test.

3. Make the following tests:

   a. Test each system function step by step as summarized in SYSTEM DESCRIPTION.

   b. Demonstrate that:

      1) Each camera station provides sharp, clear, distortion free scenes on the associated monitors for the lighting conditions.

      2) Each indoor camera station operates through full range of lighting conditions including: daylight (all fixtures off), general lighting on (at night), and night lights only (at night).

      3) Each outdoor camera station operates through a full range of lighting conditions including low lighting levels. A portion of this test must be performed at night.

      4) Each camera operates through the full range of zoom lens.

      5) Each camera housing operates through the full range of its pan and tilt capabilities.

      6) Outdoor camera station mountings are stable in wind conditions at the site.

4. Supply equipment necessary for system adjustment and testing.

5. Submit written report of test results signed by Company Field Advisor, State Representative and Director's Representative. Mount a copy of the final report in a plexiglass enclosed frame assembly adjacent to the security equipment rack.

END OF SECTION 282304

SECTION 283100 VOICE COMMUNICATION FIRE ALARM AND DETECTION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. Extent of voice communication fire alarm and detection systems work is indicated by drawings and schedules.

B. Types of voice communication fire alarm and detection systems in this section include the following:

1. Combination, Non-Coded, Intelligent, Addressable.

1.3 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of voice communication fire alarm and detection systems, of types, sizes, and electrical characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: Qualified with at least 5 years of successful installation experience on projects with voice communication fire alarm and detection systems installation work similar to that provided for project. The contractor must be Connecticut State Licensed. .

C. NEC Compliance: Comply with NEC as applicable to installation and construction of voice communication fire alarm and detection systems components and accessories.

D. UL Compliance and Labeling: Provide voice communication fire alarm and detection systems components which are UL-listed and labeled.

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1.5 INFORMATION SUBMITTALS

A. Qualification Data: For Installer and field testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For Addressable Fire Alarm and Detection System to include in the operation and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

B. Warranty: For Fire Alarm manuals specified in Form 816 Article 1.20-1.06.08 and described in NOTICE TO CONTRACTOR – CLOSEOUT DOCUMENTS.

PART 2 - PRODUCTS

2.1 VOICE COMMUNICATION FIRE ALARM AND DETECTION SYSTEMS

A. General: Noncoded, Intelligent, Addressable, microprocessor based type system with manual and automatic alarm initiation, intelligent addressable smoke detectors, and voice evacuation.

B. Functional Description: Provide a complete voice communication fire alarm & detection systems with the following functions and operating features:

1. Priority of Signals: Automatic response functions shall be accomplished by the first address initiated. Alarm functions resulting from initiation by the first address shall not be altered by subsequent alarms. An alarm signal shall be the highest priority. Supervisory or trouble signals shall have second- and third-level priority. Signals of a higher level priority shall take precedence over signals of lower priority even though the lower priority condition occurred first. Annunciate all alarm signals regardless of priority or order received.

2. Non-interfering: Provide addressable, powered, wired, and supervised system so a signal on one address does not prevent the receipt of signals from any other address. All devices shall be manually resettable from the FACP after the initiating device or devices have been restored to normal. Systems that require the use of batteries or battery backup for the programming function are not acceptable.

3. Signal Initiation: The manual or automatic operation of an alarm initiating or supervisory operating device shall cause the FACP to transmit an appropriate signal including:

   a. General alarm.
   b. Smoke detector alarm.
   c. Door release.
   d. Elevator recall.
   e. System trouble.
   f. Fan shutdown.

4. Equipment Monitoring: Provide monitor modules to monitor status of the following equipment:

   a. Elevator disconnect (shunt trip device)
   b. Generator status (position of ATS)

5. Silencing at FACP: Switches shall provide capability for acknowledgment of alarm; supervisory, trouble, and other specified signals at the FACP; and capability to silence the local audible signal and light an LED (light emitting diode). Subsequent alarms shall cause the audible signal to sound again until silenced in turn by switch operation. Restoration to normal of alarm, supervisory, and trouble conditions shall extinguish the associated LED and cause the audible signal to sound again until the restoration is acknowledged by switch operation.

6. Power Loss Indication: Sound trouble signal at the FACP upon loss of primary power at the FACP and the annunciator. Illuminate the emergency power light at both locations when the system is operating on an alternate power supply.

7. Annunciation: Annunciate manual or automatic operation of any alarm or supervisory initiating device both on the FACP and on the remote annunciator indicating the location and type device.

8. General Alarm: A system general alarm includes:

   a. Indicating the general alarm condition at the FACP and the system annunciator.

   b. Identifying the device that is the source of the alarm at the FACP and the system annunciators.

   c. Initiating audible and visible alarm signals throughout the building.

   d. Initiating automatic recall operation of elevators.

   e. Closing fire and smoke doors normally held open by magnetic door holders.

   f. Stopping supply and return fans.

   g. Closing smoke dampers on system.

   h. Initiating transmission of alarm signal to remote central station.

9. Manual station alarm operation initiates a general alarm.

10. Smoke detection initiates a general alarm.

11. Heat detection is to initiate a general alarm.

12. Sprinkler system water flow is to initiate a general alarm.

13. Sprinkler system tamper switch initiation is to initiate a trouble signal.

14. Permissible Signal Time Elapse: The maximum permissible elapsed time between the actuation of any fire alarm or fire detection system alarm initiating device and its indication at the FACP is ten seconds.

15. Circuit Supervision: Indicate circuit faults with both a zone and a trouble signal at the FACP. Provide a distinctive indicating audible tone and (LED) indicating light. The maximum elapsed time between the occurrence of the trouble condition and its indication at the FACP is 200 seconds.

16. FACP shall monitor status of stand-by generator. Elevator disconnect shall trip and shall annunciate a trouble signal from any signal from the devices.

17. System Alarm Detection and Reporting.

   a. When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

      (1) The System Alarm LED shall flash.

      (2) A local Piezo-Electric signal in the control panel shall sound.

(3) The 80-character LCD display shall indicate all information associated with the fire alarm condition, including: type of alarm point, its location within the protected premises, and the time and date of that activation.

(4) If any of the available optional serially connected equipment is being used, then each of the connected peripherals will display/print the information associated with the Fire Alarm Control Panel condition, including the time/date stamping of the change of status event.

(5) All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed, and the associated System Outputs (Alarm Indicating Appliances and/or relays) shall be activated. Unacknowledged alarm messages shall have priority over trouble messages, and if such an Alarm occurs during a Trouble sequence, the Alarm condition will have display priority.

18. System Trouble Detection:

a. When a trouble condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

(1) The System Trouble LED shall flash.

(2) A local Piezo electric signal in the control panel shall sound.

(3) The 80-character LCD display shall indicate all information associated with the Fire Alarm Trouble condition, including: type of trouble point, its location within the protected premises, and the time and date of that activation.

(4) If any of the available optional serially connected equipment is being used, then each of the connected peripherals will display/print the information associated with the Fire Alarm Control Panel condition, including the time/date stamping of the change of status event.

(5) If applicable, all system output programs assigned via control-by-event equations to be activated by the particular point in trouble shall be executed, and the associated System Outputs (Trouble Indicating Appliances and/or relays) shall be activated.

(6) Unacknowledged alarm messages shall have priority over trouble messages, and if such an Alarm occurs during a Trouble sequence, the Alarm condition will have display priority.

C. System Common Control Switch Operation

1. Acknowledge (ACK/STEP) Switch.

a. Activation of the control panel Acknowledge switch in response to a single new Alarm and/or Trouble condition shall silence the local panel Piezo electric signal and change the System Alarm or Trouble LED from flashing mode to steady-ON mode. If additional new Alarm or Trouble conditions exist or are detected and reported in the system, depression of this switch shall advance the 80-character LCD display to the next Alarm or Trouble condition.

b. In this case, the local Piezo sounder shall not silence, and the Alarm/Trouble LED's shall not transfer to their steady-ON mode, thus signaling to the operator that more Alarm/Trouble conditions are present in the system.

c. Alarm conditions shall always have display priority before Trouble conditions.

d. Depression of the Acknowledge switch shall also cause a corresponding (time-stamped) message to be displayed on all system peripheral equipment (if used).

e. Occurrence of any new Alarm or Trouble conditions in the system shall cause the Control Panel to resound the Local Piezo sounder and repeat the Alarm or Trouble sequences.

2. Signal Silence Switch:

a. Activation of the Signal Silence Switch shall cause all programmed Alarm Indicating Appliance and relays to return to the normal condition after an alarm condition. The selection of indicating circuits and relays which are silenceable by this switch shall be fully field programmable within the confines of all applicable standards.

3. System Reset Switch:

a. Activation of the System Reset Switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.

b. If the alarm condition(s) still exist, or if they re-occur in the system after System Reset Switch activation, the system shall then resound the alarm conditions.

4. System Test Switch:

a. Activation of the System Test Switch shall initiate an automatic test of all Intelligent/Addressable detectors in the system. The System Test shall activate the electronics in each intelligent sensor, simulating an alarm condition and causing the transmission of the alarm condition from that sensor to the Fire Alarm Control Panel. The Fire Alarm Control Panel shall interpret the data from each sensor installed in the system. A report summarizing the results of this test shall be displayed automatically on the System Liquid Crystal Display, as well as on any CRT's or printers in the System.

5. Lamp Test Switch:

a. Activation of the Lamp Test Switch shall sequentially turn ON all LED indicators, System Liquid Crystal Display and Local Piezo-Electric Signal, and then automatically return the Fire Alarm Control Panel to the previous condition.

D. Field Programming

1. The system shall be programmable, configurable and expandable in the field without the need for special tools or electronic equipment and shall not require field replacement of electronic integrated circuits. All programming shall be accomplished through the standard common control panel keyboard or through the use of the optional CRT-1 keyboard. All field defined programs shall be stored in non-volatile memory. The programming function shall be enabled with a special 5-digit password that may be defined specifically for the system when it is installed.

2. The password may be changed to a new value at any time by the installing Distributor. In the event that the Installing Distributor may define a password that then lose or forget it, the system shall be designed so that the valid password may be determined by special procedures available through the system manufacturer.

3. The system shall provide means for automatic programming of its operation to conform with certain NFPA Standards through internal software. The following NFPA operations are to be available through this means:

   a. NFPA 72A Local Protective Signaling Systems
   b. NFPA 72B Auxiliary Protective Signaling Systems
   c. NFPA 72C Remote Station Protective Signaling Systems

E. System Operations

1. Smoke Detector Sensitivity Adjust

   a. Means shall be provided for adjusting the sensitivity of any or all analog intelligent detectors in the system from the System keypad or from the keyboard of the CRT-1.

   b. Sensitivity range shall be within the allowed UL window, and shall be a HIGH/MEDIUM/LOW selection.

2. Alarm Verification

   a. Each of the Intelligent/Addressable Smoke Detectors in the system may be independently selected and enabled to be an alarm verified detector. The Alarm Verification Function shall be from 5-50 seconds and each detector shall be able to be enabled/disabled during the field programming of the system, or anytime after system turn-ON. The alarm verification shall not require any additional hardware to be added to the Fire Alarm Control Panel.

3. System Reports

   a. The system will be able to generate and print a summary of all of the Detectors, Modules, Pull Stations, and Zones which are currently active in the System. This printout will require password protection to prevent unauthorized user access, and will automatically print the system report using "soft" (single push) keys. No computer expertise will be required to initiate the System Report sequence.

   b. The following parameters will be printed for all installed system points whenever a "System Report" is requested:

      (1) Custom 20 character detector/module label
      (2) Detector/module type.
      (3) Detector sensitivity.
      (4) Control-by-Event equation assignments.
      (5) Waterflow Zone select.
      (6) Supervisory Zone select.
      (7) Verified Detector select.
      (8) Verification Tally Counter.
      (9) Silenceable Indicating Circuit.

4. Point Parameter Selections

a. The following parameters may be defined in the field for any of the system points, and will become a permanent part of the individual point identification. These data will be automatically displayed whenever the particular point is in the alarm or trouble mode, or whenever a "Point Status" or "System Report" is requested by the operator:

(1) Custom 20 character detector/module label
(2) Detector/module type.
(3) Detector sensitivity.
(4) Control-by-Event equation assignments.
(5) Waterflow Zone select.
(6) Supervisory Zone select.
(7) Verified Detector select.
(8) Verification Tally Counter.
(9) Silenceable Indicating Circuit.

5. Signal Silence Inhibit Time

a. The Fire Alarm System shall be equipped with a Signal Silence Inhibit feature which will prevent the operator from silencing any of the signals for a period of 90 seconds (1-255 seconds). The function of this Signal Silence Inhibit Timer shall be field programmable and it's limit shall be field definable, without the need for the installation of any hardware modules into the system.

6. Automatic Signal Cut-Out Time

a. The Fire Alarm System shall be equipped with a Automatic Signal Silence Cut-Out feature which will automatically silence all of the signals after a period of 600 seconds (1-2040 seconds selectable in 8 second increments). The function of this automatic signal silence cut-out timer shall be field programmable and it's limit shall be field definable, without the need for the installation of any hardware modules into the system.

7. System Point Operations

a. Device Disable

(1) Any device in the system may be Enabled or Disabled through the system keypad or CRT-1 without the need to reprogram or deprogram any of the operational parameters of the point such as Control-By-Event linkages, etc.

b. Output Point Control

(1) Any system output point may be turned ON or OFF from the system keypad or the CRT-1.

8. Point Read

a. The system shall be able to perform the following point status diagnostic functions without the need for peripheral equipment to make the readings. Each point will be annunciated for the parameters listed:

Detectors: Device Status
Device Type
Custom Device Label (20 character minimum)
Software Zone Label (20 character minimum)
Time and Date
Device Address
SLC Loop Number

Control Modules: Device Status
Device Type
Custom Device Label (20 character minimum)
Software Zone Label (20 character minimum)
Time and Date
Device Address
SLC Loop Number

Monitor Modules: Device Status
Device Type
Custom Device Label (20 character minimum)
Software Zone Label (20 character minimum)
Time and Date
Device Address
SLC Loop Number

Software Zones: Software Zone Status
Software Zone Type
Software Zone Label (20 character minimum)
Time and Date

Annunciator Points: Device Status
Device Type
Custom Device Label (20 character minimum)
Software Zone Label (20 character minimum)
Time and Date
Device Address
SLC Loop Number

9. System Alarm Point Display

a. Upon the receipt of an alarm condition from any point in the system, the following information shall be displayed and (optionally) printed.

Modules: Module Type
Custom Module Label (20 character minimum)
Software Zone Label (20 character minimum)
Time and Date
Module Address
SLC Loop Number

Detectors: Detector Type
Custom Device Label (20 character minimum)
Software Zone Label (20 character minimum)
Time and Date
Detector Address
SLC Loop Number

10. System Trouble Point Display

a. Upon the receipt of a trouble condition from any point in the system, the following information shall be displayed and (optionally) printed.

Modules:
Type of Trouble Condition: Invalid Reply
Open Circuit
Short Circuit
Point Trouble
Sprinkler Trouble

Device Type: Custom Module Label (20 character minimum)
Software Zone Label (20 character minimum)
Time and Date
Device Address
SLC Loop Number

Detectors:
Type of Trouble Condition: Invalid Reply
Maintenance Required
Low Chamber Value

Device Type: Custom Module Label (20 character minimum)
Software Zone Label (20 character minimum)
Time and Date
Device Address
SLC Loop Number

11. System Trouble Display (Global)

a. Upon the receipt of a Global, or System-Wide trouble condition the following information shall be displayed and (optionally) printed.

Device Status
Specific Trouble Message
Time and Date of Trouble Condition
Trouble Index Code

12. System Annunciator Trouble Display

a. Upon the receipt of a trouble condition from any annunciator in the system, the following information shall be displayed and (optionally) printed.

(1) Device Status
(2) Annunciator Module Identification
(3) Specific Trouble Message
(4) Time and Date of Trouble Condition
(5) Trouble Index Code

13. System Status Reports

a. Upon command from a password-authorized operator of the system, the following reports will be generated, and (optionally) printed:

b. System Configuration Report: A System Configuration Report will show:

(1) The number of SLC Loops in the system.
(2) The Operating Style of each installed Loop.
(3) The Alarm Verification Time for the System.
(4) The Signal Silence Inhibit Time for the system.
(5) The Automatic Signal Silence Time
(6) The Supervisory Status of the CRT
(7) CRT status line function
(8) Local Piezo signal function
(9) Local Mode Module and Detector functionality.
(10) Installed Annunciators List

c. Point Status Report: Upon command from a password-authorized operator of the system, a report will be generated which details each and every installed detector, module, zone, and annunciator, as well as any and all field programmed parameters which have been assigned to these points, and (optionally), printed:

14. System History Recording and Reporting

a. The Fire Alarm Control Panel shall contain a History Buffer which will be capable of storing up to 400 system output/input/control activations. Each of these activations will be stored and time and date stamped with the actual time of the activation, until a password authorized operator requests that the contents be either displayed, or printed.

b. The contents of the History Buffer may be manually reviewed, one event at a time, and the actual number of activations may also be displayed and or printed.

c. History Buffer Reports (whether Displayed or Printed), will be instantly distinguishable from all other displayed or printed system reports through the use of a semicolon in the time/date stamp of the data.

15. Automatic Detector Maintenance Alert

a. The Fire Alarm Control Panel shall automatically interrogate each Intelligent System Detector and shall analyze the detector responses over a period of time.

b. If any Intelligent Detector in the system responds with a reading which is below 20% of normal limits (for 5 out of 6 polls), or above 80% of normal limits for a period of 26 hours, then the system will enter the Trouble Mode, and the particular Intelligent Detector will be annunciated on the System Display, and printed on the optional System Printer.

c. This feature shall in no way inhibit the receipt of Alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.

F. Extra Materials:

1. General: Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels clearly describing contents.

2. Lamps for Strobe Units: Furnish quantity equal to 10 percent of the number of units installed, but not less than one.

3. Smoke Detectors and Heat Detectors: Furnish quantity equal to 10 percent of the number of units of each type installed but not less than one of each type.

4. Detector Bases: Furnish quantity equal to 2 percent of the number of units of each type installed but not less than one of each type.

5. Speakers: Furnish quantity equal to 2 percent of the number of units installed.

G. Available Manufacturers:

1. Siemens (Cerberus Division).
2. Simplex Time Recorder Co.
3. Notifier

2.2 MATERIALS AND EQUIPMENT

A. Alarm Initiating Devices

1. Manual Pull Stations

a. General: Double-action type, fabricated of metal or polycarbonate, and finished in red with molded raised letter operating instructions of contrasting color. Stations requiring the breaking of glass are not acceptable.

b. Reset: Key-or wrench-operated reset station switch, double pole, double throw, and rated for the voltage and current at which they operate. Provide stations with screw terminals for connections.

c. Addressability: Provide pull stations with a communication transmitter and receiver having a unique identification and status reporting capability to the FACP.

d. Provide on each manual pull station a clear cover with built in annunciator similar to STI #STI-1100, for flush mounted pull stations and STI #STI-1130 for surface mounted pull stations.

2. Smoke Detectors

a. General: Comply with UL 268, "Smoke Detectors for Fire Protective Signalling Systems." Provide the following features:

b. Factory Nameplate: With serial number and type identification.

c. Operating Voltage: 24-V d.c., nominal.

d. Self-Restoring: Provide detectors that do not require resetting or readjustment after actuation to restore them to normal operation.

e. Plug-in Arrangement: Detector and associated encapsulated electronic components mounted in a module that connects to a fixed base with a twist-locking plug connection. The plug connection shall require no springs for secure mounting and contact maintenance. Provide terminals in the fixed base for building wiring.

f. Visual Indicator: Connected to indicate detector has operated.

g. Addressability: Provide detectors with a communication transmitter and receiver having a unique identification and status reporting capability to the FACP.

h. Photoelectric Smoke Detectors: Include the following features and characteristics:

(1) Detector Sensitivity: 1.6 percent per foot smoke obscuration when tested in accordance with UL 268.

(2) Sensor: Infrared detector light source with matching silicon cell receiver.

3. Addressable Thermal Detector: Rate compensated / fixed temperature type with plug-in base and alarm indication lamp. Provide detectors with a communication transmitter and receiver complete having a unique identification and status-reporting capability to the FACP.

4. Addressable Duct Detectors: Provide Detectors which are of the intelligent photoelectric type in a duct housing with sampling tubes, and provide continuous analog monitoring of the unit's sensitivity and alarm verification from the FACP. Detectors shall be UL 268A listed, 24 VDC, rated for air velocities from 300 to 4000 feet per minute, having two Form-C auxiliary contacts, and have powered outputs for remote LED indicators.

B. Alarm Indicating Devices

1. General: Equip alarm indicating devices for mounting as indicated. Provide terminal blocks for system connections.

2. Addressable Interface Units: Unit designed to monitor system component not equipped for multiplex communication with FACP and transmit identification and status to that terminal. Provide units with a communication transmitter and receiver complete having a unique identification and status-reporting capability to the FACP.

3. Fire Alarm Speakers: 25-VRMS, flush mounted, 7 - 3/8" white round speaker with field selectable power taps of 1/4 W, 1/2 w, 1 W, and 2 Watts, and a uniform frequency response range from 400 - 4000 Hz.

a. Ceiling Speakers shall be: White.
b. Wall Mounted Speakers shall be: Red.

4. Visual Alarm Signals: 24-V d.c. strobe lights utilizing high-intensity, white or clear, optic lens, and xenon flash tube. Provide the word "FIRE" engraved in minimum 1 inch high letters displayed on the unit. Provide units with field selectable candela output of 15, 15/75, 30, 75, 110 candela via unit mounted dip switches. Units are to have a constant 1 Hz flash rate regardless of input voltage. Comply with strobe intensity and location regulations per CABO/ANSI A117.1-1992.

a. Red - System Sensor No. S1224MC, or equal.
b. Weatherproof – Similar to System Sensor No. S1224MCK, or equal.

5. Combination Signals: Provide factory-combined audible and visible alarm units in a single mounting unit where indicated.

C. Magnetic Door Holders

1. General: Magnetic door holders will be provided by the G.C. E.C. to wire per "Fire Alarm Riser Diagram" on the drawings.

D. Fire Alarm Control Panel (FACP)

1. General: Comply with UL 864, "Control Units for Fire Protective Signaling Systems."

2. Cabinet: The control panel shall be housed in a cabinet designed for mounting directly to a wall or vertical surface. The back box and door shall be constructed of .060 steel with provisions for electrical conduit connections into the sides and top. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. The cabinet shall be approximately 5 inches deep and 24 inches wide. Height shall be approximately 46 inches. The control unit shall be modular in structure for ease of installation, maintenance, and future expansion.

3. System Capacity and General Operation: The control panel shall provide or be capable of expansion to the following capacities:

a.	Intelligent/Addressable Loops		10
b.	Intelligent Detectors per Loop		99
c.	Addressable Modules per Loop		99
d.	Total Intelligent Detectors		990
e.	Total Addressable Monitor or Control Modules		990
f.	Total Intelligent/Addressable devices per system		1980
g.	Peripheral Devices and Appliances:		
	(1)	Remote Annunciators per System	32
	(2)	Points per Annunciator	64
	(3)	Total Annunciator Points per system	1048
	(4)	Remote Printers per System	6
	(5)	Remote CRT's per System	24

4. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel which shall include a backlit 80 character liquid crystal display, 5 individual, color coded system status LED's, and an alpha-numeric keypad for the Field Programming and Control of the Fire Alarm System. All programming or editing of the existing program in the system may be achieved without special equipment and without interrupting the alarm monitoring functions of the Fire Alarm Control Panel.

5. Loop Interface Board: One Loop Interface Board shall be provided to monitor and control each of the Signaling Line Circuit (SLC) Loops in the system. The Loop Interface Board shall contain its own microprocessor, and shall be capable of operation in Local Mode in the case of a failure in the main CPU of the Control Panel. The Loop Interface Board shall not require any jumper cuts or address switch settings to initialize SLC Loop operations, or to differentiate the discreet Loop Interface Boards within the Control Panel. This operation will allow the Control Panel to self address and configure all Loop Interface boards within the system environment.

6. The Loop Interface Board shall provide power to, and communicate with, all of the Intelligent/Addressable Detectors and Addressable Modules connected to its SLC Loop over a single pair of wires. The SLC Loop shall be capable of operation as either a Style 4, Style 6, or as a Style 7 SLC Loop. When using a Style 4 SLC Loop, each SLC Loop shall be a shielded, twisted pair cable of up to 10,000 feet in length, and the Loop Interface Board-200 shall be able to drive 2 channels of these SLC Loops, each up to 10,000 feet in length, for an effective Loop span of 20,000 feet.

7. The Loop Interface Board shall receive analog information from all Intelligent Detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for the particular detector. The analog information may also be used for

automatic detector testing and for the automatic determination of detector maintenance requirements.

8. The Loop Interface Board shall communicate with each Intelligent/Addressable Detector and Addressable Module on its SLC Loop and verify proper device function and status. Communication with up to 198 Intelligent/Addressable devices shall be performed every 6 seconds or less. Average time to detect an alarm shall be 3 seconds (longer for detectors which utilize alarm verification).

9. Central Processing Unit: The Central Processing Unit shall communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the System Common Control Annunciator by the Central Processing Unit. The Central Processing Unit shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Such control by event programs shall be held in non-volatile programmable memory (NVRAM), and shall not be lost even if system primary and secondary power failure occurs.

10. The Central processing Unit shall also provide a real-time clock for time annotation of all system displays. The Time-Of-Day and Date shall not be lost if system primary and secondary power supplies fail. The Central Processing Unit shall provide a single Form C General Alarm Contact, and a single Form C General Trouble Contact, rated at 5A (30VDC) minimum.

11. Display Interface Assembly: The System Display shall be the system common control/annunciator, and shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters. The Display Interface Assembly shall contain, and display as required, the custom alphanumeric label for all Intelligent Detectors and Addressable Modules. Such label information shall be stored in programmable nonvolatile memory (NVRAM).

12. The System Display shall provide an 80-character alphanumeric Liquid Crystal Display (LCD). It shall also provide 5 Light Emitting-Diodes (LED's), which will indicate the status of the following system parameters:

a.	AC POWER;	Green LED
b.	SYSTEM ALARM;	Red LED
c.	SYSTEM TROUBLE;	Yellow LED
d.	DISPLAY TROUBLE;	Yellow LED
e.	SIGNAL SILENCE	Yellow LED

13. The System Display shall provide a 25-key touch key-pad with control capabilities to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels will be accessible through the Display Interface Assembly to prevent unauthorized System control or programming.

14. The System Display shall include the following operator control switch:

a. SIGNAL SILENCE
b. LAMP TEST
c. RESET
d. SYSTEM TEST
e. ACKNOWLEDGE

15. Graphic Panel: Provide 24” x 36” floor plan drawing of entire building both floors, mounted in vandal resistant frame drawing shall indicate information necessary to locate all fire alarm devices quickly in conjunction with fire alarm annunciator.

16. Serial Interface Boards

a. Model Number SIB-64 - The SIB-64 shall be an optional system accessory, and shall provide the following interfaces:

(1) One port for the operation of up to (2) two PRN-2 Printers. This port may be used for the operation of the Color Graphics Annunciation System (CGAS). One port for the operation of one CRT-1, and up to 24 additional CRT-1 units used as slave monitors.

1) The use of the SIB-64 shall not in any way decrease any of the capacities of the system.

17. Visual signal module: Provide visual signal synchronization module(s) in the FACP to synchronize all strobes.

E. Voice Alarm Multiplex System

1. General: The Audio Subsystem shall include, but not limited to: control panel electronics, alarm indicating peripheral devices, conduit, wire and accessories required to provide a complete and operational system. Comply with UL 864, "Control Units for Fire Protective Signaling Systems", NFPA 72, and NFPA 72F, "Emergency Voice/Alarm Communications Systems".

2. Mechanical Design: The Audio Subsystem shall be housed in the same cabinet as the intelligent addressable fire alarm system. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. The cabinet shall be approximately 5 inches deep and 24 inches wide. Height shall be approximately 46 inches. The control unit shall be modular in structure for ease of installation maintenance, and future expansion.

3. Audio Amplifier: The Audio Amplifier will provide up to 120 Watts of Audio Power (25 volts RMS) each, for distribution to the speaker circuits.

4. Multiple Audio Amplifiers will be mounted in the Main Fire Alarm Control Panel, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s). The Audio Amplifier shall include an integral power supply, and shall provide the following controls and indicators:

a. Normal Audio Level LED
b. Incorrect Audio Level LED
c. Brownout LED
d. Battery Trouble LED
e. Amplifier Trouble LED

5. Audio Amplifier Gain Adjust - Normally Open Trouble Contacts (to annunciate one of the following conditions):

a. Loss of Audio
b. Battery Trouble
c. A.C. Loss/Brownout
d. Style D Circuit Fault

6. Adjustment of the correct Audio Level for the Amplifier shall not require any special tools or test equipment. All terminal blocks for the connection of field wiring shall be removable plug and socket type to allow for ease of field wire installation and troubleshooting.

7. Audio Message Generator: The Audio Message Generator will provide a recorded audio evacuation message for use with the Transponder. The Audio Message Generator shall have the capacity to record a custom message for this evacuation message, and will record this message in Electrically Programmable Read Only Memory (EPROM), or in Non-Volatile Random Access Memory (NVRAM), without the use of moving parts.

8. The Audio Tone Generator (ATG-2) provides user-selected tones for single-or dual-channel output. The ATG-2 shall generate either a slow whoop, H/LO or steady tone on the primary (EVAC) channel. In dual-channel operation, the ATG-2 shall generate either a chime or a 20 pulses-per-minute tone on the secondary (alert) channel. The ATG-2 shall include a built-in microphone with a Page Select switch which allows for paging through speaker circuits on either or both channels. If employed with an optional Fire Fighters Telephone (FFT-7), the Audio Tone Generator shall provide a system paging capability from telephones installed throughout the installation.

9. The ATG-2 shall also serve as a remote paging microphone. Under this configuration the ATG-2 shall relay the audio message (or tone) received from an AMG-1 or another ATG-2 while allowing override paging capabilities from the ATG-2 microphone. Up to 50 AA-30 or AA-120 Audio Amplifiers may be driven directly by the ATG-2. Unless configured for remote paging microphone operation, all communication is accomplished through a Bell Circuit connection with the system.

10. Voice Telephone Command Center: The voice telephone command center shall provide the fire alarm control panel with a fire fighters telephone subsystem.

11. A Fire-Fighters master handset and telephone system master control will provide an on-line "Common talk" capability of up to 7 handsets, and will provide LEDs to annunciate the telephone subsystem status, including PAGE MODE, ON LINE, PHONE TROUBLE, LINE TROUBLE conditions. The Fire-Fighters master handset and telephone system master control will allow page by phone operation for any connected speaker zone within the protected premises.

12. The Voice Telephone Command Center will include an Audio Message Generator with a hand-held microphone, which will provide the system with a recorded audio evacuation message for use with the Transponder. The Audio Message Generator shall have the capacity to digitally record up to 4 custom messages, or play back up to 4 previously recorded messages, for the emergency evacuation of the protected premisses. These pre-recorded emergency messages will be recorded in Non-Volatile RAM memory, without the use of moving parts.

13. The Audio Message Generator shall provide up to 4 digitally recorded voice messages and not require moving parts such as motors, solenoids, belts, or capstans to allow the playback of the pre-recorded emergency message.

14. Up to 2 Emergency messages may be recorded in the field using either the rebuilt in microphone, or a Standard audio cassette tape recorder as a source.

15. If, for any reason, the pre-recorded message fails, the Audio Message Generator will automatically switch to a primary evacuation tone, and generate a system trouble sequence.

16. The Audio Message Generator shall provide a variety of field selectable pre-announce tones, including slow whoop.

17. The Audio Message Generator shall provide a built-in microphone for operator initiated paging through the speaker circuits in the protected premises.

18. The Audio Message Generator shall have the following controls and indicators to allow for proper operator understanding and control of the audio subsystem in an emergency situation:

    a. Audio Level Normal LED
    b. All Call LED
    c. On-Line LED
    d. Amplified Trouble LED
    e. Speaker Trouble LED
    f. All Call Switch
    g. Local Speaker Volume Control

19. Audio Subsystem Operations: Each Audio Subsystem shall be powered from a local 120 VAC source, and shall provide all power necessary for its own operation, including battery charging and backup circuits. The Audio Subsystem shall be capable of providing up to 4 channels of Fire Alarm evacuation signals. The alarm evacuation signals may be made through a microphone or through a pre-recorded message panel.

20. Field Programming

    a. The system shall be programmable, configurable and expandable in the field without the need for special tools or PROM programmers and shall not require replacement of memory ICs. All programming may be accomplished through the standard control panel keyboard or through the use of the optional CRT-1 keyboard. All programs shall be stored in non-volatile memory.

    b. The programming function shall be entered with a special password that may be selected when the system is installed. The password may be changed in the field to a new value at any time by entering the old password and requesting a password change. In the event that the programmer may enter a password and then lose or forget it, the system shall be designed such that the password may be determined by special procedures available through the system manufacturer.

F. System Power Supplies

1. The Main Power Supply for the Fire Alarm Control Panel shall be integral to the control panel itself, and shall provide all control panel and peripheral device power needs, as well as 3 amperes of regulated 24 VDC power for Audio-Visual alarm indicating devices. Provisions will be made to allow the Audio-Visual power to be increased as required by adding modular expansion Audio-Visual power supplies. The Power Supplies shall be designed to meet UL and NFPA requirements for power-limited operation on all indicating and initiating circuits. Positive-temperature-coefficient thermistors, circuit breakers, or other over-current protection shall be provided on all power output. Input power shall be 120 VAC, 60 HZ. The power supply shall provide an integral Dual-Rate Battery Charger for use with batteries up to 23 AH. This integral Battery Charger will automatically inhibit the deep discharge of the system standby batteries, and shall be protected against the accidental reverse polarity connection of the standby batteries. The Main Power Supply may also be used with external battery and charger systems.

2. Battery back-up power capacity shall be provided for 24 hours of system operation and capable of operating the system for 15 minutes at full load.

3. The Main Power Supply shall continuously monitor all field wires for Earth Ground conditions, and shall have the following LED indications:

   a. Negative Ground Fault LED
   b. Positive Ground Fault LED
   c. Battery Fail LED
   d. AC Power Fail LED

G. Audio Visual Power Supply

1. The Audio Visual Power Supply for the Fire Alarm Control Panel shall be integral to the control panel itself, and shall provide 3 amperes of unrelated 24 VDC power for Audio-Visual alarm indicating devices. Provisions will be made to allow the Audio-Visual power to be increased as required by the addition of more Audio-Visual power supplies. All power supplies shall be designed to meet UL and NFPA requirements for power-limited operations on all external circuits.

2. Positive-temperature-coefficient thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs. Input power shall be 120 VAC, 60 HZ. The power supply shall be capable of being backed up with a standby battery, or may be used with external battery and charger systems. Battery arrangement may be configured in the field. All standby power connections shall be supervised.

H. Printer

1. The Printer shall provide hard-copy printout of all changes in status of the system and shall time stamp such printouts with the current time-of day and date. The printer shall be standard carriage with 80- characters per line and shall be standard pin-feed paper. The printer shall be enclosed in a separate cabinet suitable for placement on a desk top or table. The printer shall communicate with the control panel using an interface complying with Electrical Industries Association standard EIA-232D. Power to the printer shall be 120 VAC 60 HZ.

I. Auto-Dialer

1. Provide a fire control communicator which is two zone, digital, UL listed for NFPA 71 and 72C applications, dual telephone lines, primary and alternate telephone lines, communicates using BFSK or pulsed single-round fast format, automatic test reports every 24 hours, two sockets for optional additional relays, phone trouble LED, phone trouble buzzer.

2. Digital Auto Dialer: Provide an automatic programmable speech dialer with two alarm inputs designed for verbal reporting of two separate events. Each event shall be reportable to four different remote telephones. Dialer shall have a dual function, built-in microphone for recording verbal messages and for listen-in purposes.

3. Monitoring agency shall be FM approved.

2.3 WIRING METHODS

A. Conduit and Conductors: Provide complete wiring and conduit between all equipment. Unless otherwise specified within the Installation Manual of the specific equipment being used, all field wiring shall be minimum #16 (solid) or #14 (stranded) copper conductors, installed in separate

conduit, maximum 40% full, and shall be approved for use as Fire Alarm cable. All notification appliance circuits (NAC) shall be loaded no greater than 70% of full load. The maximum voltage drop allowable for NAC circuit calculation is 10%. Audible and Visible signals shall be wired on separate circuits. Conduit of proper size shall be installed from the Control Panel Equipment to field devices.

B. All field devices shall be mounted upon U.L. Listed Electrical junction boxes.

C. All splices in field wiring shall be made in U.L. Listed Electrical junction boxes.

D. All Electrical junction boxes shall be labeled as "Fire Alarm System" with decal or other approved markings. The Fire Alarm/Life Safety Installation shall comply fully with all local, State and National Codes, and the Local Authority having Jurisdiction (AHJ).

E. Conduit shall enter into the Fire Alarm control panel backbox only at those areas of the backbox which have factory conduit knockouts.

F. All field wiring shall be completely supervised, In the event of a primary power failure, disconnect standby battery, removal of any internal modules, or any open circuits in the field wiring; an audible and visual trouble signal will be activated until the system and its associate field wiring are restored to normal condition.

G. Open cable shall be allowed above ceilings and in other areas allowing surface wiring if so approved by the Local Authority Having Jurisdiction. All cable shall be protected where entering or leaving a junction box or device box with a portable cord straight grip connector such as Bridgeport #770-4, or equal.

H. Cable shall be the type listed for Fire Alarm/Life Safety use and shall be installed per NEC Article 760.

I. Cable must be separated from any open conductors of power, or class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, as per NEC Article 760-29.

J. All exposed cable below 84 inches from the surface of the finished floor, or to other locations where the cable may become exposed and/or damaged, must be within a steel conduit.

K. Conduits must also be provided in elevator shafts and hoistways. Cables within ducts or plenums must conform with the specifications of NEC Article 300-22.

L. Riser and wiring diagrams prepared by Engineer are not intended as final installation drawings but only as a guide for bidding. Install system based on final wiring diagrams prepared by the manufacturer of the system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install voice communication fire alarm & detection systems as indicated, in accordance with equipment manufacturer's written instruction, and complying with applicable portions of NEC, and NECA's "Standard of Installation".

B. Manual Pull Stations: Unless otherwise indicated mount semi-flush in recessed back boxes with operating handles 48" above finished floor.

C. Smoke Detectors: Install detectors indicated to be ceiling mounted not less than 4 inches from a side wall to the near edge. Install detectors located on the wall at least 4 inches but not more than 12 inches below the ceiling. For exposed solid joist construction, mount detectors on the bottoms of the joists. On smooth ceilings, install detectors not over 30 ft. apart in any direction. Install detectors no closer than 5 ft. from air registers.

D. Audible Alarm Indicating Devices: Install not more than 96" above the finished floor nor less than 6" below the ceiling. Unless otherwise indicated, install horns on flush mounted back boxes with the device operating mechanism concealed behind a grille. Combine audible and visible alarms at the same location into a single unit.

E. Visual Alarm Indicating Devices: Install adjacent to each alarm bell or alarm horn. Install not more than 96" above the finished floor and at least 6" below the ceiling.

F. Fire Alarm Control Panel (FACP): Surface mount with tops of cabinets not more than 6 ft. above the finished floor.

G. Wire Guards: Provide wire guards on smoke detectors, heat detectors, and horn/strobe units in all garage spaces.

3.2 INSTALLATION OF BASIC IDENTIFICATION

A. Install electrical identification in accordance with Section 260040, "Identification".

3.3 INSTALLATION OF BASIC WIRING SYSTEM MATERIALS

A. Install wiring, raceways, and electrical boxes and fittings in accordance with Division-26 Basic Materials and Methods sections "Raceways", "Wires and Cables", and "Electrical Boxes and Fittings".

B. Install fire-stopping products for all open cables runs through fire-rated construction as specified in specification Section 260010 “Basic Electrical Requirements”.

3.4 FIELD QUALITY CONTROL

A. Inspect relays and signals for malfunctioning, and where necessary, adjust units for proper operation to fulfill project requirements.

B. Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of voice communication fire alarm & detection systems equipment.

C. Provide three service organization inspections for each system at four-month intervals during the year following final acceptance. Correct defects found in the systems at the time of these inspections.

D. The contractor must retain the services of the fire alarm system manufacturer for the following minimum requirements:

1. To perform and assist the electrical contractor in the installation of the fire alarm system.

2. Perform testing of all devices (pull stations, smoke and heat detectors and A/V units, etc.) for alarm, supervision and trouble conditions.

3. Provide two (2) - 4 hour training sessions (separate days) dedicated to training the owner in the complete operation and maintenance of all system components and control panel.

4. Provide testing reports indicating each device tested and consistent with NFPA 72.

5. Perform acceptance testing with the authority having jurisdiction.

6. And any other functions deemed necessary.

E. The contractor shall provide full testing of the system with the authority having jurisdiction (AHJ) present, including the following:

1. The testing of the system shall be in accordance with the procedures outlined in NFPA 72, including section 7-1.6, System Reacceptance Testing, for existing software functions and devices. Testing of smoke detectors shall be with smoke or listed aerosol approved by the detector manufacturer.

2. Retest the system until all deficiencies have been rectified.

3. The contractor shall submit a written test report signed by the manufacturers representative indicating that the fire alarm system has been 100% tested and approved prior to the acceptance test.

4. The contractor shall conduct an acceptance test of every component required in the presence of the owner, owners representatives and the authority having jurisdiction.

5. Rectify all deficiencies identified at the acceptance test at no cost to the owner and reschedule a retest of the system

END OF SECTION

SECTION 283300 - WIRELESS CLOCK SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Comply with Division 1 - General Requirements, as well as Division 1 High Performance Buildings Requirements, Section 018113.13.

1. HPB credits may be related to this section. HPB credits shall be reviewed for their potential applicability and conformed with as though listed

1.2 SUMMARY

A. Provide a complete operable clock system using materials and equipment of types, sizes, ratings, and performances as indicated in both drawings and specifications. Use materials and equipment that comply with referenced standards and manufacturer's standard design and construction, in accordance with published product information.

1.3 DEFINITIONS

A. GPS: Global Positioning System, a worldwide system that employs 24 satellites in an integrated network to determine geographic location anywhere in the world, and which employs and transmits atomic time, the most accurate and reliable time.

1.4 SYSTEM DESCRIPTION

A. Clock system shall continually synchronize clocks throughout the facility, and shall be capable of clock readouts in multiple time zones where desired.

B. Time system shall be a synchronized master-satellite time system. The system shall synchronize all clocks to each other. The system shall utilize GPS technology to provide atomic time. The system shall not require hard wiring. Clocks shall automatically adjust for Daylight Savings Time.

C. Clocks shall be synchronized to within 10 milliseconds 6 times per day, and the system shall have an internal oscillator that maintains plus or minus one second per day between synchronizations, so that clock accuracy shall not exceed plus or minus 0.2 seconds.

D. The system shall include an internal clock so that failure of the GPS signal shall not cause the clocks to fail in indicating time.

E. The system shall incorporate fail-safe design so that failure of any component shall not cause failure of the system. Upon restoration of power or repair of failed component, the system shall resume normal operation without the need to reset the system or any component thereof.

F. Clock locations shall be as indicated, and the clocks shall be fully portable, capable of being relocated at any time.

1.5 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of clock systems, of types, sizes, and electrical characteristics required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer: Qualified with at least 5 years of successful installation experience on projects with clock systems installation work similar to that provided for project, and factory authorized to provide service for that system.

C. NEC Compliance: Comply with NEC as applicable to installation and construction of clock system components and accessories.

D. UL Compliance and Labeling: Provide clock system components which are UL-listed and labeled.

E. Permits: Obtain operating license for the transmitter from the FCC.

1.6 REGULATORY REQUIREMENT

A. Equipment and components furnished shall be of manufacturers' latest model.

B. Transmitter and receiver shall comply with Part 90 of FCC rules, as follows:

1. The equipment shall not cause harmful interference.

2. The equipment shall accept interference that will cause adversely on equipment operation.

3. Transmitter frequency shall be governed by FCC Part 90.35.

4. Transmitter output power shall be governed by FCC Part 90.257 (b).

C. System shall be installed in compliance with local and state authorities having jurisdiction.

1.7 SUBMITTALS

A. Product Data: Submit complete catalog data for each component, describing physical characteristics and method of installation. Submit brochure or color card showing available colors and finishes of clocks.

B. Operating License: Submit evidence of application for operating license prior to installing equipment. Furnish the license, or if the license has not been received, a copy of the application for the license, to the Owner prior to operating the equipment. When the license is received, deliver original license to Owner.

C. Samples: Submit one clock for approval. Approved sample shall be tagged and shall be installed in the work at location directed.

D. Manufacturer's Instructions: Submit complete installation, set-up and maintenance instructions.

E. Include data in operation and maintenance manuals per Section 260500.

1.8 SUBSTITUTIONS

A. Proposed substitutions, to be considered, shall be manufactured of equivalent materials that meet or exceed the specified requirements of this section.

B. Other systems requiring wiring and/or conduit between master and clocks, or which require connection of clocks to external electrical power supply will not be acceptable.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver all components to the site in the manufacturer's original packaging. Packaging shall contain manufacturer's name and address, product identification number, and other related information.

B. Store equipment in unopened containers until ready for installation. Store in building in finished, air conditioned space.

1.10 PROJECT SITE CONDITIONS

A. Clocks shall not be installed until painting and other finish work in each room is complete.

B. Coordinate installation of GPS receiver with work on the roof or exterior side wall so that the bracket and related fasteners are watertight.

1.11 SYSTEM STARTUP

A. At completion of installation and prior to final acceptance, start up the equipment; assure that all equipment is operating properly, and that all clocks are functioning.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Master-Satellite Time System shall be as manufactured by Primex Wireless or Sapling, Inc.

2.2 SEQUENCE OF OPERATION

A. Transmitter Operation: When power is first applied to the transmitter, it checks for and displays the software version, then it checks the position of the switches and stores their position in memory. The transmitter then looks for the GPS time signal. Once the transmitter has received the GPS time, it sets its internal clock to that time. The transmitter then starts to transmit its internal time once every second. The transmitter updates its internal clock every time it receives valid time data from the GPS.

B. Clock Operation:

1. When the batteries are inserted into the clock: A) Press the red button when the red second hand is at the 12:00 position. At this time the microprocessor will lock in the location of the second hand. B) After the red second hand has passed over the minute hand (first second hash mark after minute hand), press and release the red button. At this time the microprocessor will lock in the location of the minute hand. The microprocessor then assumes the location of the hour hand.

2. After the red button has been pressed twice, the microprocessor will start searching the channels. It will start at channel no. 1 and proceed one by one until it either decodes a valid signal or reaches channel no. 16. If no signal is detected the receiver will be shut off and try again later. If a signal is received, the microprocessor will store the channel number, set the clock too the receive time, then for the next minute the clock will beep every time it receives a valid time signal. If the clock is in a good signal area it will beep once per second. If the clock beeps every few seconds, the clock is in a marginal signal area. Clocks should operate in marginal signal areas, but battery life will be about 25% shorter.

3. After initial set, the clock will shut off the receiver. On a pre-scheduled basis, the microprocessor will turn the receiver back on and starting with the stored channel, it will again look for a valid time signal. However, the beeper will not operate.

4. If the clock has not decoded a valid time signal for seven days, then it will go back to a double step mode. Non signal reception can be caused by low battery voltage. If this occurs, replace the batteries.

2.3 EQUIPMENT

A. General: The time system shall include a transmitter, a roof or window mounted GPS receiver, indicating clocks, and all accessories for complete installation.

B. Transmitter: Primex Wireless Model FM-72, consisting of wireless transmitter with GPS receiver. Unit shall obtain current atomic time from satellite. The clock system shall transmit time continuously to all clocks in the system.

1. Transmission:

a.	Frequency Range:	1 watt at 72.100 to 72.400 MHz.
b.	Transmission Range:	1 mile, open field.
c.	Radio Technology:	Narrowband FM.
d.	Number of Channels:	16
e.	Channel Bandwidth:	20 kHz maximum.
f.	Transition Mode:	1-way communication
g.	Data Rate:	2 Kbps.
h.	Operating Range:	0 degrees C. to 70 degrees C.

2. Transmitter:

a.	Transmitter Output Power:	+30 dBm (1 watt)
b.	Frequency Deviation:	+/- 4kHz
c.	Transmitter Power Requirements:	120 VAC, 60 Hz
d.	Internal Power Requirements:	5 volts DC
e.	Carrier Frequency Stability:	+/- 20 ppm

3. Transmitter shall have 16 selectable channels to assure interference-free reception.

4. Transmitter shall have the following switches:

   a. Time zone adjust switches for all time zones in the world. Includes all US time zones: Eastern, Central, Mountain, Pacific, Alaska, and Hawaii.

   b. Daylight saving time bypass switch.

   c. 12-hour or 24-hour display.

5. Transmitter housing shall be black metal case, 16-3/4" by 12" by 1-7/8" in size.

6. Internal Antenna shall be 46" high, commercial type, mounted on top center of transmitter housing as recommended by system manufacturer.

7. Transmitter housing shall incorporate a display which shall include the following:

   a. Time Readout.
   b. AM and PM indicator if 12 hour time display is set.

c. Day and Date readout.
d. Indicator for daylight savings or standard time.
e. LED which shall flash red in event of reception problem.
f. GPS reception indicator.

8. Transmitter shall contain an internal clock such that failure of reception from the GPS will not disable the operation of the clocks.

C. Power Supply:

1. Model Number: Q11666
2. Input: 120 volt AC 50/60 Hz, 0.4 amps.
3. Output: 9 volt DC, 1.5 amps.

D. GPS Receiver: Model # Q11722, GPS roof mounted, with 200' Primex wireless cable.

1. The GPS receiver shall be a complete GPS receiver including antenna in a waterproof case, 3-7/8" by 4-3/16" by 2", designed for roof or outdoor mounting. Provide mounting bracket for attachment to roof structure.

E. Clocks: Primex wireless clocks, 12-1/2" diameter as selected, color and finish as selected from manufacturer's standard colors and finishes. Clocks shall be wall mounted, and 12-1/2" diameter clocks shall have polycarbonate frame and polycarbonate lens. Face shall be white. Hour and minute hands shall be black. Clocks shall be provided with red sweep second hand.

1. Clocks shall be battery operated, and shall have 5 year battery life.

2. Clocks shall be capable of automatically adjusting for daylight savings time. An on-off switch located on the transmitter shall disable this function if desired.

3. Time shall be automatically updated from the transmitter 6 times per day.

4. Clocks shall remember the time during changing of batteries.

5. Clock Lock: Tamper-proof / theft resistant hangers and slots in the backs of clocks.

6. Provide 2 alkaline D cell batteries with each clock.

7. Clock receivers shall be as follows:

a. Decode sensitivity: > -110 dBm
b. Receiver Power: 2 alkaline "D" cells
c. Antenna Type: Internal.
d. Antenna Gain: -7 dBd.

8. If transmitter stops transmitting valid time signals due to power failure, the clocks will continue to function as accurate quartz clocks until a valid time signal is decoded.

F. Wire Guards:

1. Model number 14131, 14" x 14" size, for nominal 12.5" diameter clocks.
2. Model number 14123, 18" x 18" size, for nominal 16" diameter clocks.

G. Cable Connection Sealant: As recommended by system manufacturer.

1. Transmission:

a.	Frequency Range:	1 watt at 72.100 to 72.400 MHz.
b.	Transmission Range:	1 mile, open field.
c.	Radio Technology:	Narrowband FM.
d.	Number of Channels:	16
e.	Channel Bandwidth:	20 kHz maximum.
f.	Transition Mode:	1-way communication
g.	Data Rate:	2 Kbps.
h.	Operating Range:	0 degrees C. to 70 degrees C.

2. Transmitter:

a.	Transmitter Output Power:	+30 dBm (1 watt)
b.	Frequency Deviation:	+/- 4kHz
c.	Transmitter Power Requirements:	120 VAC, 60 Hz
d.	Internal Power Requirements:	5 volts DC
e.	Carrier Frequency Stability:	+/- 20 ppm

3. Transmitter shall have 16 selectable channels to assure interference-free reception.

4. Transmitter shall have the following switches:

   a. Time zone adjust switches for all time zones in the world. Includes all US time zones: Eastern, Central, Mountain, Pacific, Alaska, and Hawaii.

   b. Daylight saving time bypass switch.

   c. 12-hour or 24-hour display.

5. Transmitter housing shall be black metal case, 16-3/4" by 12" by 1-7/8" in size.

6. Antenna shall be 46" high, commercial type, mounted on top center of transmitter housing. Antenna gain shall be > 110 dBm. Antenna polarization shall be data logic, zero to 5 volts.

7. Transmitter housing shall incorporate a display which shall include the following:

   a. Time Readout.
   b. AM and PM indicator if 12 hour time display is set.
   c. Day and Date readout.
   d. Indicator for daylight savings or standard time.
   e. LED which shall flash red in event of reception problem.
   f. GPS reception indicator.

8. Transmitter shall contain an internal clock such that failure of reception from the GPS will not disable the operation of the clocks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that construction is complete in spaces to receive equipment and that rooms are clean,, dry, and permanent air conditioning systems are operating.

B. Verify that 120 volt electrical outlet is located within 6 feet of location of transmitter, and that outlet is operational and properly grounded.

3.2 INSTALLATION

A. Install clock system as indicated on drawing and specifications, in accordance with equipment manufacturer's written instruction, and complying with applicable portions of NEC.

B. GPS Unit: Install on roof in location indicated, in clear view of the sky. Install unit in location free from standing water, and above accumulations of leaves or debris. Seal cable connection to GPS with cable connection sealant. Provide roof portal to pass cable through roof assembly from GPS Unit to Transmitter.

C. Transmitter:

1. Locate transmitter where indicated, a minimum of 2 to 3 feet above the floor, away from large metal objects such as filing cabinets, lockers, or metal framed walls.
2. Attach receiver to transmitter using coaxial cable.
3. Connect antenna to transmitter, using care not to strip threads.
4. Connect power supply to the transmitter.
5. Set the channel number on the display to correspond to the FCC license.
6. Plug power supply into electrical outlet.

D. Clocks: Perform the following operations with each clock:

1. Install “D” cell batteries.

2. Set clock to correct time in accordance with manufacturer’s instructions.

3. Observe clock until valid signals are received and clock adjusts itself to the correct time.

4. Install the clock on the wall in the indicated location, plumb, level and tight against the wall. Attach using clock-lock hanging method and suitable fasteners as approved by clock manufacturer.

3.3 INSTALLATION OF BASIC IDENTIFICATION

A. Install electrical identification in accordance with Section 260553 "Electrical Identification".

3.4 INSTALLATION OF WIRE GUARDS

A. Provide wire guards on all clocks indicated with “WG” on plans. All clocks in gymnasiums, storage rooms, mechanical rooms, electrical rooms, and work shops are to have wire guards.

B. Wire guards are to be secured to wall, using approved theft-resistant fasteners.

3.5 ADJUSTING

A. Prior to final acceptance, inspect each clock, adjust as required, and replace parts which are found defective.

3.6 CLEANING

A. Prior to final acceptance, clean exposed surfaces of clocks, using cleaning methods recommended by clock manufacturer. Remove temporary labels from clock faces. Do not remove labels from backs of clocks.

3.7 DEMONSTRATION

A. Provide training to Owner's representative on setting and adjusting clocks, replacing batteries and routine maintenance.

3.8 PROTECTION

A. Protect finished installation until final acceptance of the project.

END OF SECTION 283300

SECTION 300000 - FORM 816 SITE WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Description: This Section includes site work descriptions, materials and construction methods excerpted and edited from the State of Connecticut Department of Transportation, The Standard Specifications for Roads, Bridges and Incidental Construction, Form 816, 2004 including supplemental specifications. The work includes, but not limited to, the identified excerpted Sections.

B. Related Requirements:

1. State of Connecticut Department of Transportation, The Standard Specifications for Roads, Bridges and Incidental Construction, Form 816, 2004 including supplemental specifications; Division I, General Requirements and Covenants and Division III, Materials Section; exclusive of references to Method of Measurement and Basis of Payment.

2. Division 01, Construction Waste Management Section 017419.

3. Division 01, High Performance Buildings Section 018113.13 for credit 16a-38k-3(h) and 16a-38k-4(e15).
   a. The above listed HPB credit is related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

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1.4 EXCERPTED SECTIONS

SECTION 2.01 - CLEARING AND GRUBBING

2.01.01 Description:

This work shall consist of clearing the ground of trees, stumps, brush, rubbish and all objectionable material in accordance with these specifications or as directed by the Engineer. This work shall also include the clearing of the ground necessary for the construction and installation of drainage, structures, ditches, channels, fences and other appurtenances. Included in this work shall be the preservation from injury or defacement of vegetation and objects designated to remain.

2.01.03 Construction Methods:

The Contractor shall mark all trees, shrubs and plants to be removed in accordance with the plans and these specifications. The Engineer shall have 7 days to field review the markings and make any adjustments prior to the start of the clearing operation. Within the excavation lines all trees shall be cut off and stumps removed to a depth of not less than 12 inches (300 millimeters) below the graded surface.

Within the fill lines where an embankment is to be made not more than 5 feet (1.5 meters) in depth, trees, stumps, roots, etc., shall be removed. Where the embankments to be made exceed 5 feet (1.5 meters) in depth, trees, stumps, roots, etc., shall be cut off to within 6 inches (150 millimeters) of the ground surface.

In areas where clearing is necessary for the construction and installation of various appurtenances, all trees and stumps shall be cut flush with the ground; and all dead or uprooted trees, brush, roots or otherwise objectionable material shall be removed as directed unless otherwise indicated on the plans. Prior to clearing operations, a meeting must be held. Those attending the meeting should include the Contractor, the Engineer, the designer, local tree warden or equivalent, and the District Environmental Coordinator. All clearing issues shall be resolved to the satisfaction of the Engineer before any trees are cut.

All trees scheduled to be removed outside of the proposed gutter or curb lines shall be visibly marked or flagged by the Contractor at least seven days prior to cutting of such trees.

The Engineer will inspect the identified trees within 7 days of the marking of the trees and verify the limits of clearing and grubbing prior to the Contractor proceeding with his cutting operation.

All branches of trees extending within the roadway shall be trimmed as directed to provide a 16-foot (5-meter) minimum vertical clearance including selective trimming of such trees as directed.

The Contractor shall dispose of all such trees, stumps, brush, etc., in a satisfactory manner and shall remove all rubbish and refuse from within the project limits.

All excavations made below subgrade surface by the removal of trees, stumps, etc., shall be filled with suitable material, which shall be compacted thoroughly in accordance with the provisions governing formation of embankments.

All fences, stonewall fences and ornamental and utilitarian domestic accessories, such as, but not limited to garden pools, arbors, stair railings, fireplaces, sheds and incinerators, within the project limits shall be removed as directed.

All road signs, mail boxes, etc., shall be removed and reset as directed.

SECTION 2.02 ROADWAY EXCAVATION, FORMATION OF EMBANKMENT AND DISPOSAL OF SURPLUS MATERIAL

2.02.01 Description:

Roadway excavation shall consist of the removal and satisfactory disposal, in the manner herein required, of all material taken from within the limits of the work contracted for, the removal of which is necessary for the construction of the roadway, subgrade, shoulders, slopes, entrances, retaining walls, gutters, channels, swales and other miscellaneous construction to the dimensions and limits shown on the plans or as ordered and shall include the necessary excavation for pervious structure backfill outside of structure excavation limits. It shall also include the formation of embankments, the disposal of surplus or unsuitable material, removal of old foundations, concrete or masonry walls, crib walls, bin walls, stone wall fences or farm wall fences and filling of cellar or other holes, and the shaping and cleaning of slopes and of shoulders.

1. Earth Excavation shall include all materials removed as indicated or directed except water, "Rock," "Channel Excavation—Earth," and "Channel Excavation—Rock."

2. Rock Excavation shall include rock in definite ledge formation and boulders, or the portion of boulders, 1 cubic yard (cubic meter) or more, in volume.

3. Channel Excavation—Earth shall include all materials other than water or "Channel Excavation Rock" removed from the existing new or temporary water courses as indicated on the plans or as directed.

4. Channel Excavation—Rock shall include rock in definite ledge formation and boulders of 1 cubic yard (cubic meter) or more in volume removed from existing, new or temporary water courses, as indicated on the plans or as directed.

2.02.03 Construction Methods:

Excavation shall be made in conformity with the requirements of the plans and as ordered by the Engineer. The Contractor shall, when necessary in excavation areas, provide and maintain ditches which are adequate to prevent free water from becoming incorporated in material to be used to form embankments, such ditching to be at the sole expense of the Contractor. Where buildings have been removed to clear the way for construction or where old foundations, concrete or masonry walls exist, they shall be removed to 2 feet (600 millimeters) below the directed or finished grading; and all cellar and other holes shall be filled with suitable material.

1. Sod and other organic matter shall be disposed of as directed by the Engineer. In the event the Engineer does not direct the disposal of unsuitable material in conformance with Subarticle 300000-2.02.03-8, the Contractor has the option of disposing of the unsuitable material as specified within Subarticle 300000-2.02.03-10.

2. Frozen material, otherwise suitable for formation of embankments, shall be placed on embankment slopes or dispose**d** of as directed by the Engineer. The Engineer may direct the removal of any portion of an accepted layer which has become frozen after placement and compaction. This frozen material shall be placed on embankment slopes or disposed of as directed by the Engineer. The removal and placement of frozen material shall be at the sole expense of the Contractor.

3. Topsoil shall be excavated within pavement and shoulder limits at grade points and to an elevation 3 feet (1 meter) below finish grade and elsewhere as directed. The material excavated may be used in the construction of embankments, if permitted by the Engineer, and shall be thus used if the Engineer so directs. In all cases, the use of topsoil in constructing embankments shall be restricted to locations where the surface of the underlying material is dry, its distance above the free water surface at the time of filling is more than 3 feet (1 meter), and its distance below finish pavement grade is more than 5 feet (1.5 meters).

4. Excavation of Rock: When rock is encountered, it shall be excavated to the slope lines and depths indicated on the plans.

   The Contractor shall presplit the rock along the proposed rock slopes to the lines and inclinations shown on the plans except as otherwise provided in the specifications. Presplitting will be required where the backslope is designed at an inclination one (vertical) on one (horizontal) or steeper or where the cut in rock is ten feet (3 meters) or more, measured on the inclination of the proposed slope from the bottom of excavation to the natural surface of sound rock. The maximum vertical height of slope face which can be presplit at any one time shall be 50 feet (15 meters).

   The presplitting holes shall follow the required rock slope lines and inclinations. Hole drilling shall commence only when solid rock is encountered and exposed to the satisfaction of the Engineer. Unless otherwise permitted by the Engineer, presplitting holes shall have a spacing of 3 feet (1 meter), center-tocenter, and a diameter not greater than 3 inches (75 millimeters). The holes shall be extended from the top of solid rock surface to the toe of finished rock slope, unless lesser depths are specified on the plans. The proper angle of drilling shall be maintained at all times so all presplit holes lie essentially in the same plane and are paralleled to each other. No holes shall deviate more than 6 inches (150 millimeters) at any place in the plane of the specified slope line nor in its vertical alignment. If any cut is presplit by vertical stages (lifts), the presplit holes may be offset, for each stage, a distance not more than 24 inches (600 millimeters) inside the previously presplit face. Presplit holes shall be lightly loaded with a continuous column charge manufactured especially for presplitting. All space in each hole not occupied by the explosive charge shall be filled with clean stone chips less than 3/8 inch (9 millimeters) in size or approved equal. Charges near the top of hole shall be reduced sufficiently to eliminate overbreak and heaving. The top charge shall not be less than 3 feet (1 meter) below the top of the drill hole. The methods of detonation shall be such that a uniform plane of rupture of the rock occurs from top to bottom and between presplit holes. If necessary, the Contractor shall adjust the methods as outlined above so as to result in a uniform plane of rupture in the rock.

   Unless otherwise approved by the Engineer, presplit holes shall be drilled at least 50 feet (15 meters) ahead of, and shall be detonated prior to the drilling and blasting, the general pattern holes within the section of any lift of rock to be excavated. The presplitting shall be performed so as to produce a uniform plane of rupture in the rock such that the resulting rock face will not be affected by subsequent blasting and excavation operations.

   In the general pattern, blasting following presplitting operations, no portion of any blast hole shall be drilled closer than 4 feet (1.2 meters) to the presplit face. No portion of any blast hole larger than 3 inches (75 millimeters) in diameter shall be permitted closer than 12 feet (3.5 meters) to the presplit face. The spacing of blast holes, distribution and type of explosives, methods of detonation, and the blasting techniques shall be adjusted by the Contractor according to the characteristics and structure of the rock encountered so as not to fracture the rock beyond the presplit face.

   Prior to any blasting, the Department will call a blasting conference at which the Contractor shall be represented to determine the methods to be used and the required protection to insure the utmost safe-

ty during blasting operations. The Contractor shall be responsible for all damage due either directly or indirectly to such operation.

The Contractor shall schedule his operations so that all rock excavation within a distance of 100 feet (30 meters) of bridge or other large structures, or any portion thereof, is completed to the required slope lines and depths before any structure work is started.

All loose and unstable material and all breakage and slices shall be removed as directed and as the excavation for each vertical stage (lift) progresses. It shall be, at all times, the responsibility of the Contractor to perform all phases of this work to produce the required rock slope faces to the satisfaction of the Engineer.

Where indicated on the plans or as ordered by the Engineer, rock shall be excavated without the use of explosives. Excavation methods by the use of drilling, splitting, wedging or other approved methods not involving the use of explosives shall be utilized. The method selected by the Contractor shall allow excavation to the slope line(s) and depth(s) as shown on the plans and shall not affect in any way the material or structures outside the excavation line or grade.

5. Placement of Embankment Material: All excavated material and reclaimed waste obtained within the limits of the project shall be used in the formation of embankments, except as provided elsewhere herein or as ordered by the Engineer.

   Overhaul will not be allowed; but excavated material shall be transported where directed, provided the designated point of deposit is not more than 100 yards (100 meters) beyond the limits of the work contracted for, unless stated otherwise in the plans.

   When embankments are to be constructed on slopes steeper than 1 vertical to 3 horizontal, the slope of the existing ground on which the embankment is to be placed shall be plowed deeply or cut into steps before the filling is begun.

   Embankments shall be constructed of earth, rock, reclaimed waste or a mixture thereof containing no more than 2% by weight (mass) of asphalt cement. The embankment shall be constructed by depositing successive layers of fill for the full width of the embankment, unless a partial width is permitted by the contract documents or by the Engineer. If glass and/or clinker are included in reclaimed waste, their individual particles shall be no larger than 1 inch (25 millimeters) in size. Glass and/or clinker shall be thoroughly mixed with other embankment materials such that their content anywhere in the embankment shall not exceed 25% by weight (mass), with the exception that material placed within 5 feet (1.5 meters) from the face of the slope shall be free of glass and clinker. No embankment layer shall be deposited on surfaces of snow or ice, nor shall it be placed on frozen or unstable surfaces except under the conditions permitted elsewhere herein. If the Contractor is permitted to continue work, he shall remove, at no cost to the State, any frozen embankment material unless otherwise directed by the Engineer.

   The depth of each layer, before compaction, shall not exceed 12 inches (300 millimeters) except as permitted hereinafter by these specifications, or with the permission of the Engineer.

   The embankment shall be crowned or pitched to provide drainage at the close of each day's operations. Where filling in 12-inch (300-millimeter) layers is impracticable, as in the case of filling in water or over slopes too steep for the operation of equipment, the embankment may be constructed in one layer to the minimum elevation at which equipment can be operated, as determined by the Engineer; and above this elevation, the embankment shall be constructed as specified herein.

Embankments to an elevation 3 feet (1 meter) above the free water surface at the time of filling, shall be constructed of rock or free-draining material, or a mixture of both. Free-draining material shall conform to the requirements of Article M.02.07.

In fills where the top of the proposed pavement will be less than 4 feet (1.2 meters) above an existing flexible pavement, and the existing pavement is not required to be removed, it shall be scarified as directed by the Engineer.

In fills where the top of the proposed pavement will be less than 3 feet (1 meter) above an existing concrete pavement, including all bituminous resurfacing thereon, the concrete pavement shall be removed. In fills where the top of the proposed pavement will be between 3 and 4 feet (1 meter and 1.2 meters) above an existing concrete pavement, the concrete pavement shall be broken in such a manner that complete fractures are obtained. Intact fragments, undamaged after breaking, shall not be larger than 2 square feet (0.2 square meters).

When present pavement not in cut or fill is removed, as called for on the plans or directed, the area shall be backfilled with a suitable earth material which shall be free from admixture of subsoil, refuse, stumps, roots, rocks, brush, weeds and other material which will prevent the formation of a suitable seed bed. Wherever portions of existing concrete pavement are to be removed, such removals shall be made to neat lines. The areas in which such concrete surfaces are to be removed will be delineated by the Engineer before such work is done. Where no break or joint exists in the concrete pavement at the line of delineation, a kerf, at least 2 inches (50 millimeters), but no more than 3 inches (80 millimeters) deep, shall be made in the concrete with an approved concrete cutting saw. The concrete shall then be removed from within the delineated area exercising extreme care to avoid "breakbacks" beyond the kerf, break or joint. Concrete pavement remaining in place shall have vertical edges, and that portion below the kerf shall be reasonably smooth.

Wherever portions of existing bituminous concrete pavement are to be removed, they shall be removed to neat lines as shown on the plans or as directed by the Engineer. Where the delineated limits of the areas in which such bituminous surfaces are to be removed are adjacent to existing bituminous concrete pavement that is to remain in place, the line of delineation shall be cut by a method approved by the Engineer. When the embankment material consists predominantly of rock fragments and/or fragments of reclaimed waste of such size that material cannot be placed in horizontal layers of the thickness specified above without crushing or further breaking down the pieces resulting from the excavation methods, such material may be placed in the embankments in horizontal layers not exceeding 3 feet (1 meter) in thickness. Large stones or fragments of reclaimed waste shall not be placed in nests but shall be distributed over the area; and the interstices shall be filled with spalls, finer fragments or earth to form a solid, compact mass. The entire area of each layer shall be leveled off by suitable grading equipment and shall be compacted as hereinafter specified.

In portions of embankments where piles are to be driven, the Contractor shall not place any material which might interfere with pile driving operations. The correction of any condition which interferes with the pile driving operations in embankments constructed under the contract shall be made by the Contractor at no cost to the State.

No rock fill or reclaimed waste containing fragments over 12 inches (300 millimeters) in their greatest dimension shall be placed above an elevation which is 2 feet (600 millimeters) below the top of the embankment.

No particle over 5 inches (130 millimeters) in its greatest dimension shall be placed within 12 inches (300 millimeters) of the elevation of the top of the prepared subbase unless otherwise specifically au-

thorized. Prior to the formation of any embankment, the Contractor may submit a plan in a form acceptable to the Engineer for grading operations detailing the location of embankment material sources and points of deposit for the entire project.

6. Compaction: The entire area of each layer of the embankment and the subgrade in the excavated areas shall be uniformly compacted to at least the required minimum density by use of compaction equipment consisting of rollers, compactors or a combination thereof. Earth-moving and other equipment not specifically manufactured for compaction purposes will not be considered as compaction equipment. The dry density after compaction shall not be less than 95% of the dry density for that soil when tested in accordance with AASHTO T 180, Method D. Each layer of the embankment and the subgrade shall be compacted at optimum moisture content. No subsequent layer shall be placed until the specified compaction is obtained for the previous layer.

7. Stability: If after full compliance with the requirements of these specifications with regard to excavation, placement and compaction density requirements, a stable embankment or subgrade has not been obtained, the Contractor shall proceed to perform such corrective work as is necessary to produce a stable embankment or subgrade. This work may include, but not necessarily be limited to control of moisture to within limits suitable for obtaining the required stability; blending with rock or granular material from project excavation or borrow, or free draining material or combination thereof; removal and replacement with acceptably compacted material or a combination of these methods approved by the Engineer. The foregoing methods may be supplemented by suspending embankment operations and allowing the material to dry.

8. Surplus Excavated Material: All surplus excavated material shall be used where directed by the Engineer, to uniformly widen embankments, to flatten slopes, to fill low places in the project limits, or for such other purposes as the Engineer may direct, provided the area designated for deposit does not conflict with Subarticle 300000-2.02.03-5.

   Any surplus or unsuitable material not required, nor permitted to be used for such purposes, shall be disposed of in accordance with Subarticle 300000-2.02.03-10.

9. Disposal of Unsuitable Material: When the Engineer has not directed otherwise, the Contractor has the option to dispose of unsuitable excavated material by one or both of the following methods:

   a) By removing such material from within the limits of the project and disposing of such material at point or points as the Contractor shall determine provided this does not create any detrimental effects to the project and the Engineer does not object to the area selected for disposal.

   b) By disposing of such material within the limits of the project in accordance with the details and requirements shown on the plans and the following requirements: Not less than 15 days prior to disposing of any such material within project limits, the Contractor shall submit to the Engineer for his approval a proposal delineating the locations and extent of the areas in which he intends to dispose of such material. The proposal shall describe the nature of the material and the methods to be employed in placing and covering the material. The proposal will be reviewed for its effects on the completed construction and the environment. The proposal shall be amended as required by the Engineer. No such material shall be disposed of within project limits until the proposal has been approved by the Engineer.

      All work shall be done in accordance with the approved proposal.

Suitable material excavated for the disposal of the unsuitable excavated material shall be placed in the embankment in accordance with the requirements of Section 300000-2.02 or shall be used to cover the unsuitable excavated material.

The State does not guarantee nor imply that the areas available for disposal of unsuitable excavated material within project limits will be adequate for the disposal of all unsuitable excavated material to be removed. The Contractor shall dispose of all unsuitable excavated material in excess of that which can be placed within the permitted areas.

10. Slopes: Earth slopes with a degree of slope from 2:1 to 5:1 shall be tracked unless the Engineer directs that they shall not be tracked. Tracking shall consist of traversing the slopes with cleated tracks so that the cleat indentations are horizontal. Where topsoil is to be placed on slopes, the tracking shall be done prior to the installation of the topsoil.

    Tracking is not to be construed to be used for slope compaction. Its sole purpose is to provide indentations in the slope to help reduce soil erosion. Other methods of achieving the desired results may be used, with the permission of the Engineer.

SECTION 2.03 STRUCTURE EXCAVATION

2.03.01—Description:

With the exceptions noted below, structure excavation shall include the removal of all material of whatever nature, the removal of which is necessary for the construction of foundations of bridges, box culverts, retaining walls, and other structures shown on the plans; the placing of all necessary fill with the exception of pervious structure backfill hereinafter specified; and the wasting of excavated material which is not required for backfilling or embankment, or which is unsuitable for that purpose.

This work shall also include dewatering; the design and construction of all cofferdams and related environmental controls used in dewatering operations required for the execution of the work; the repair, reconstruction and removal of cofferdams and related environmental controls used in dewatering operations; and the removal of all obstructions necessary for the construction of cofferdams. For "Cofferdam and Dewatering" the provisions of Section 300000-2.04 shall govern.

"Structure Excavation—Earth" or "Structure Excavation—Rock" are defined as follows:

1. "Structure Excavation—Earth" shall include removal of all materials, other than water or "Structure Excavation—Rock."

2. "Structure Excavation—Rock" shall include the removal of rock in definite ledge formation; boulders or portions of boulders that have a volume of 1 cubic yard (cubic meter) or greater; and masonry structures of 1 cubic yard (cubic meter) or more in volume.

2.03.03—Construction Methods:

1. Dimensions and Elevations of Footings: The elevations of the bottom of footings, as shown on the plans, shall be considered as approximate only; and the Engineer may order, in writing, such changes in dimensions or elevations of footings as may be necessary to secure a satisfactory foundation.

2. Preparation of Foundations: All rock or other suitable foundation material shall be cleared of all overlying material, cleaned and cut to a firm surface, either level, stepped or serrated, as directed by the Engineer. All seams shall be cleaned out and filled with concrete, mortar or grout. Any over-breakage in rock more than 6 inches (150 millimeters) below the plan grade for the bottom of the footing not authorized by the Engineer shall be replaced by the Contractor with Class "A" concrete at the Contractor's expense. When the structure is to rest on a material other than rock, special care shall be taken not to disturb the material below the bottom of the excavation; and the final removal of the foundation material to grade shall not be made until just before the forms for concrete or masonry are placed. Any foundation material disturbed below plan grade or revised plan grade shall be dressed and compacted at the Contractor's expense. This shall not apply, however, when a granular fill foundation course is required.

3. Cofferdams: If a cofferdam is required it will be designed and constructed in accordance with the provisions of 300000-2.04.03—1 and 3.

4. Dewatering: If a cofferdam is required dewatering will be performed in accordance with the provisions of Subarticle 300000-2.04.03—2.

5. Inspection: After each excavation is completed, the Contractor shall notify the Engineer; and no construction shall be started until the Engineer has approved the depth of the excavation and the character of the foundation material.

6. Fill Adjacent to Structures: All spaces excavated and not occupied by the abutments, piers, other permanent work or pervious structure backfill shall be filled to the surface of the surrounding ground with suitable material. Such backfill shall be thoroughly compacted and neatly graded.

Fill placed around arches, rigid frames, box culverts and piers shall be deposited on both sides of the structure to approximately the same elevation at the same time.

Each layer of backfill shall be spread to a thickness not exceeding 6 inches (150 millimeters) in depth after compaction and shall be thoroughly compacted by the use of power rollers or other motorized vehicular equipment, by tamping with mechanical rammers or vibrators, or by pneumatic tampers. Any equipment not principally manufactured for compaction purposes or which is not in proper working order in all respects shall not be used within the area described above.

Special attention shall be given to compaction in places close to walls where motorized vehicular compaction equipment cannot reach. Within 3 feet (1 meter) of the back face of walls and within a greater distance at angle points of walls, each layer of backfill shall be compacted by mechanical rammers, vibrators or pneumatic tampers.

The dry density of each layer of backfill after compaction shall not be less than 95% of the dry density for that material when tested in accordance with AASHTO T180, Method D. In conducting this test, material retained on the 3/4-inch (19-millimeter) sieve size shall be replaced with material retained on the No. 4 (4.75- millimeter) sieve, as noted as an option in the specifications for this test.

Adequate provision shall be made for the drainage of all fill in accordance with the provisions of the plans, or as ordered by the Engineer.

Each layer of backfill shall be compacted at optimum moisture content. No subsequent layer shall be placed until the specified compaction is obtained for the previous layer.

No fill shall be placed against any structure until the Engineer has given permission to do so, and in no case until after the permitted time for removal of forms.

SECTION 2.05 TRENCH EXCAVATION

2.05.01—Description:

Trench excavation shall consist of the removal and satisfactory disposal of all materials, the removal of which is necessary for the proper completion of the work, to the dimensions shown on the plans or as ordered, and backfilling, all in accordance with these specifications for the following:

1) The construction of pipe culverts, endwalls, catch basins, drop inlets, manholes, underdrains and outlets, sewers, service pipes.

2) The removal of storm water drainage structures, storm water pipes and appurtenances beyond the limits of the roadway and structure excavation.

3) The removal of miscellaneous items such as abandoned underground tanks, pipelines, etc.

Classification:

(1) Trench excavation will be allowed only for the construction of the structures and the removals definitely specified above.

(2) Rock in Trench: Rock, insofar as it applies to trench excavation, shall be defined as rock in definite ledge formation, boulders, or portions of boulders, cement masonry structures, concrete structures, reinforced concrete pipe, Portland cement concrete pavement or base, of 1/2 cubic yard (0.5 cubic meters) or more in volume or removed as indicated.

2.05.03—Construction Methods:

Trench excavation shall be made in conformity with the requirements of the plans or as ordered. The Contractor shall furnish and employ such shores, braces, pumps, etc., as may be necessary for the protection of property, proper completion of the work and the safety of the public and employees of the Contractor and the Department. All bracing, etc., shall be removed when no longer required for the construction or safety of the work.

When a drainage structure is to be eliminated, it shall be completely removed and all pipes plugged with cement masonry or removed completely.

Where the plans or contract documents show that a drainage structure is to be abandoned, the structure shall be removed to a depth 2 feet (600 millimeters) below the subgrade or to the depth shown on the plan.

The floor of the structure shall be broken and all pipes shall be plugged with cement masonry.

Wherever portions of existing concrete pavement that would otherwise remain in place must be removed in conjunction with trench excavation, such removals shall be made to neat lines. The areas in which such concrete pavements are to be removed will be delineated by the Engineer before such work is done. Where no break or joint exist in the concrete pavement at the line of delineation, a full depth cut shall be made in the concrete with a concrete cutting saw approved by the Engineer. The concrete shall then be removed from within the delineated area, exercising extreme care to avoid “breakbacks” beyond the saw-cut or joint. Concrete pavement remaining in place shall have vertical edges.

Wherever the concrete pavement to be removed has been overlaid with bituminous concrete and the adjacent bituminous concrete pavement is to remain in place, the bituminous pavement shall be removed to a neat line that is 1 foot (300 millimeters) beyond the neat line for the concrete pavement removal.

Wherever portions of existing full-depth bituminous concrete pavement are to be removed in conjunction with trench excavation, they shall be removed to neat lines. Where the limits of the areas in which such bituminous pavement is to be removed are adjacent to existing bituminous concrete pavement that is to remain in place, the limits shall be cut by a method approved by the Engineer.

After the excavation is completed, the Contractor shall notify the Engineer; and no masonry, pipe or other material shall be placed in the excavated area until the Engineer has approved the depth of excavation and the character of the foundation material.

When backfilling is required, the material used shall be of a quality satisfactory to the Engineer and shall be free from large or frozen lumps, wood and other extraneous material. All backfill shall be placed in layers of not more than 6 inches (150 millimeters) in depth after compaction and shall be thoroughly compacted by means of mechanical rammers or vibrators or by pneumatic tampers. Hand tampers shall be used only upon written permission of the Engineer. Unless otherwise ordered by the Engineer, the backfill shall be brought to the surface of the surrounding ground and neatly graded.

All suitable material removed in making the excavation shall be used for backfill if required. All surplus or unsuitable material shall be removed and disposed of as directed. Should additional material be required for backfilling, it may be obtained from the Project excavation or from borrow pits, gravel pits, or elsewhere as the Engineer may direct.

Each layer of backfill shall be compacted to optimum moisture content. No subsequent layer shall be placed until the specified compaction is obtained for the previous layer.

Fill placed around pipes shall be deposited on both sides to approximately the same elevation at the same time. Rock fill or stones larger than 2 inches (50 millimeters) shall not be placed closer than 2 feet (600 millimeters) from the pipes on the sides as well as the top.

No backfill shall be placed against any structure until permission shall have been given by the Engineer.

SECTION 2.07 BORROW

2.07.01—Description:

When the amount of usable material excavated within the limits of the work contracted for is not sufficient to form the embankments and other features of the work, additional material shall be furnished by the Contractor from borrow pits obtained by him at his expense and located beyond the limits of the project. This material shall be known as borrow. Borrow shall include the furnishing, removing and satisfactory placing of the additional material necessary to complete the embankments and other features of the work.

Stockpiled hydraulically dredged and/or reclaimed waste material containing no more than 25% of glass or clinker by weight (mass) and no more than 2% by weight (mass) of asphalt cement may be used for part or all borrow requirements. Stockpiles shall be placed at locations arranged for and provided by the Contractor at his expense and will not be allowed within the project limits except at locations and under conditions stipulated by the Engineer. All permits, easements, rights or other requirements related to dredging and stockpiling shall be the obligation and responsibility of the Contractor.

2.07.02—Materials:

Borrow, excluding hydraulically dredged borrow, shall conform to all the requirements of Article 300000-2.02.03 for performance when incorporated in embankments. For purposes other than embankments, it shall be of a satisfactory quality as determined by the Engineer for the purpose intended. Hydraulically dredged borrow shall contain not more than 20% by dry weight (mass) of material passing the No. 200 (75-micron) sieve when placed in the embankment.

2.07.03—Construction Methods:

Borrow will be permitted only to the extent necessary to complete the embankments and similar details and only after all usable material from the excavation has been placed. With the approval of the Engineer, the Contractor may be permitted to place borrow before the excavation is completed; but he will be held responsible for the proper placing of all suitable excavated material. This permission may be revoked by the Engineer at any time if in his opinion satisfactory progress is not maintained on other operations.

The Contractor shall notify the Engineer at least 5 days prior to obtaining material from any borrow pits so that an examination may be made of the fitness of the material. The limits of the proposed borrow pit shall be shown to the Engineer, the Contractor shall be required to clear the area of all unsuitable material. No excavation shall be made within the confines of a borrow pit other than for material to be used in the formation of embankments or elsewhere as shown on the plans or as directed by the Engineer; except that material may be taken for contract work other than borrow with the permission of the Engineer under terms and conditions set forth in writing.

If the Contractor elects to obtain borrow from a commercial pit, it will be necessary for him to have a section of the pit set off for his use solely.

If the Contractor elects to obtain borrow from a stockpile of reclaimed waste, he shall obtain approval from the Engineer prior to removing any material from the stockpile to the job site. Once the stockpiles have been tested and approved, no additional material shall be added to them.

If the Contractor uses hydraulically dredged material, he shall, at his expense, employ effective dust control measures so that the public will not be adversely affected by dust from stockpiled material or such

material in transit. The Contractor shall also provide and maintain at his expense effective and adequate drainage for all dredging and stockpiling operations at all times, and he shall be solely responsible for all damages which result from dredging and stockpiling and for the continuing maintenance and final restoration of all drainage facilities affected by his operations.

Stockpiles of hydraulic material shall be reserved for exclusive use of the State.

Dredging to a stockpile and removing material there from simultaneously is expressly prohibited.

Borrow shall be placed where directed and in accordance with the provisions for the formation of embankments of Article 300000-2.02.03.

SECTION 2.08 FREE-DRAINING MATERIAL

2.08.01—Description:

Free-draining material shall consist of material conforming to the requirements stated elsewhere herein. This material shall be furnished and placed in accordance with these specifications and as indicated on the plans, or as ordered by the Engineer for the stabilization or embankments, or for fill in free water areas, or wherever specified.

2.08.02—Materials:

Material for this work shall meet the requirements of Article M.02.07.

2.08.03—Construction Methods:

The Contractor shall notify the Engineer at least 3 days prior to obtaining free-draining material from any source so that an examination may be made of the material.

The limits of the proposed source shall be shown to the Engineer and the Contractor shall be required to clear the area of all unsuitable material.

The Contractor may, with the approval of the Engineer, obtain free-draining material, if available, from within the roadway excavation limits subject to the provisions of Article 1.04.07.

If the Contractor elects to obtain free-draining material from a commercial pit, it will be necessary for him to have a section of the pit set off for his use solely.

If the Contractor elects to use stone from a quarry or reclaimed miscellaneous aggregate, the Contractor shall use only the materials from stockpiles which have been approved for use.

Free-draining material will be permitted only to the extent necessary to construct embankments to 3 feet (1 meter) above free water, or to promote free drainage in areas specified on the plans, or as directed by the Engineer.

Free-draining material shall be placed in accordance with the provisions for the formation of embankment of Section 300000-2.02.

SECTION 2.09 SUBGRADE

2.09.01—Description:

The area upon which the pavement structure and paved shoulders are placed, including the shoulder base courses and subbase, shall be known as the subgrade. This is the plane coincident with the bottom of the subbase and the edge of pavement, as shown on the plans and cross sections or as ordered by the Engineer. The work of formation of subgrade shall be performed at this plane.

Where precast concrete barrier curb is to be permanently installed, the work of formation of subgrade shall be performed on the area under the precast concrete barrier curb.

Where shoulders are to be reconstructed and the existing subbase is to remain, the work of formation of subgrade shall be performed at the plane coincident with the surface of the existing subbase.

After all grading has been substantially completed and all drains laid, the subgrade shall be brought to the lines, grades and cross-sections shown on the plans.

2.09.03—Construction Methods:

All soft and yielding material and other portions of the subgrade which will not compact readily shall be removed and replaced with suitable material.

In cut areas, the surface shall be uniformly compacted by use of equipment specifically manufactured for that purpose. Rollers shall deliver a ground pressure of not less than 300 pounds per linear inch (52.5 newtons/millimeter) of contact width and weigh not less than 10 tons (have a mass of not less than 9100 kilograms). Vibratory units shall have a static weight of not less than 4 tons (mass of not less than 3650 kilograms). The amount of compactive effort shall be as directed by the Engineer, but in no case shall be less than four (4) complete passes of the compacting equipment being used.

The dry density after compaction shall be as specified in Subarticle 300000-2.02.03-6.

Where more than one compacting unit is to be used, that unit which exerts the larger compactive effort shall make the initial passes. Any portion of the subgrade not accessible to larger compacting units shall be compacted, as directed by the Engineer, to a degree equal to that obtained on the other portions of the subgrade with equipment and by methods appropriate to the size of the inaccessible area.

After compacting, the subgrade shall be true to required line and grade.

The Contractor shall protect the completed subgrade from damage by exercising such precautions as the Engineer deems necessary. The subgrade surface shall be maintained in such condition as to permit proper drainage. It shall be checked and approved by the Engineer prior to placing any pavement structure and shoulders thereon.

SECTION 2.10 WATER POLLUTION CONTROL (SOIL EROSION)

2.10.01—Description:

This work shall consist of measures to control water pollution and soil erosion through the use of berms, dikes, dams, sediment basins, erosion control matting, gravel, mulches, grasses, slope drains, ditches, channels, riprap, grading to control surface runoff and other erosion control devices or methods.

If the Contractor proposes changes in construction or his scheduling which would affect the designed pollution controls, he shall submit plans before starting construction for revised pollution controls for the approval of the engineer.

The Contractor shall submit a plan showing erosion and sedimentation controls above and beyond those called for in the plans and/or specifications, necessitated by the proposed sequence of operations and/or construction activities. The construction shall not proceed until the erosion and sedimentation control plans have been approved by the Engineer. The Engineer may order additional control measures if the measures mentioned above prove insufficient.

Refer to Division 01, High Performance Buildings Requirements Section 018113.13 for credit 16a-38k-3(h).

The above listed HPB credit is related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2.10.02—Materials:

The materials shall conform to the pertinent articles of the Standard Specifications and approved by the Engineer, or other materials approved by the Engineer, such as:

(a) Soil tackifiers, erosion control matting, burlap, and plastic sheets. All materials shall be clean and free from noxious weeds, contaminants, and debris deleterious to plant growth. Erosion control matting shall conform to Sections 300000-9.50 and M.13.

(b) Slope drains or ditches may be constructed of pipe, rubble, riprap, sod, burlap, plastic sheets, portland cement concrete, bituminous concrete, or other material approved by the Engineer.

(c) Seeding shall conform to Sections 300000-9.50 and M.13.

2.10.03—Construction Method:

The Engineer has the authority to control the surface area of earth material exposed by construction operations and to direct the Contractor to immediately provide permanent or temporary pollution control measured to prevent contamination of adjacent streams, watercourses, lakes, ponds or other areas of water impoundment. Every effort shall be made by the Contractor to prevent erosion on the site and abutting property.

All slopes shall be stabilized by mulching, seeding or otherwise protected as the work progresses to comply with the intent of this specification.

All seeding shall include mulch or other protective covering approved by the Engineer.

When hay is used as a mulch with seeding, it shall be a minimum of 2 inches (50 millimeters) deep and held down with a tackifier.

When wood fiber mulch is used, it shall be applied in a water slurry at a rate of 2000 pounds per acre (900 kilograms/4000 square meters) with or immediately after the application of seed, fertilizer and limestone.

All damaged slopes shall be repaired as soon as possible. The Engineer shall limit the surface area of earth material exposed if the Contractor fails to sufficiently protect the slopes to prevent pollution.

The Contractor shall at all times have on hand the necessary materials and equipment to provide for early slope stabilization and corrective measures to damaged slopes.

Temporary channels, ditches and outfalls shall be protected prior to directing water into them to prevent erosion.

The erosion control features installed by the Contractor shall be maintained by the Contractor, and he shall remove such installations if ordered by the Engineer. Maintenance of erosion control measures by the Contractor shall include the clean out of accumulated sediment.

The Contractor shall operate all equipment and perform all construction operations so as to minimize pollution. The Contractor shall cease any of his operations which will increase pollution during rain storms.

The Contractor shall give the Engineer sufficient notice of impending shutdowns to enable the Engineer and Contractor to examine the project and to implement erosion and pollution control work.

SECTION 2.12 SUBBASE

2.12.01—Description:

The subbase shall consist of a clean soil-aggregate mixture of bank or crushed gravel, crusher run stone, reclaimed miscellaneous aggregate containing no more than 2% by weight (mass) of asphalt cement or any combinations thereof, placed where shown on the plans or where directed by the Engineer and constructed in accordance with these specifications.

2.12.02—Materials:

All materials for this work shall conform to the requirements of Articles M.02.02 and M.02.06.

2.12.03—Construction Methods:

The prepared foundation for the subbase shall be carefully shaped to the required cross-section and compacted as specified in Article 300000-2.02.03. Where underdrains and outlets are specified on the plans or ordered by the Engineer, they shall be in place and functioning before any subbase material is placed.

The subbase material shall be spread uniformly upon the required grade, in courses not to exceed 6 inches (150 millimeters) in thickness after final compaction. However, if the required thickness of subbase does not exceed 8 inches (200 millimeters), it may be placed in one course.

After each course has been placed as specified above, its entire area shall be compacted with equipment specifically manufactured for that purpose. The sole use of hauling and spreading equipment shall not be considered as a substitute for compacting equipment. Compaction shall be continued until the entire course is uniformly compacted to the required minimum density. The dry density after compaction shall not be less than 95% of the dry density for that subbase material when tested in accordance with AASHTO T-180, Method D. If a subbase course is formed from reclaimed miscellaneous aggregate containing bituminous concrete, the wet density after compaction on this course shall not be less than 95% of the wet density for that subbase when tested in accordance with AASHTO T180, Method D.

Each layer of subbase shall be compacted at optimum moisture content. No subsequent layer shall be placed until the specified compaction is obtained for the previous layer.

Should the foundation material beneath the subbase become churned up and mixed with subbase material at any time, the Contractor shall, without additional compensation, remove the mixture and replace it with new subbase material to the required thickness shown on the plans or as previously required by the Engineer. Such replaced subbase material shall be compacted to the required minimum density.

SECTION 2.13 GRANULAR FILL

2.13.01—Description:

This material shall be used as a foundation for structures, to replace unstable material in slopes, as a foundation for sidewalks and culverts, in shoulders and elsewhere as indicated on the plans, required by the specifications or ordered by the Engineer. It shall consist of gravel or reclaimed miscellaneous aggregate containing no more than 2% by weight (mass) of asphalt cement conforming to the requirements of these specifications.

2.13.02—Materials:

Granular fill shall conform to the requirements of Article M.02.01

2.13.03—Construction Methods:

When granular fill is used for foundation for structures or to replace rock or unsuitable material in trenches, it shall be deposited in layers not over 6 inches (150 millimeters) in depth, with each layer thoroughly compacted before the addition of other layers.

SECTION 2.14 COMPACTED GRANULAR FILL

2.14.01—Description:

Work shall consist of furnishing and placing compacted granular fill as foundation for structures where shown on the plans or directed by the Engineer.

2.14.02—Materials:

Gravel or reclaimed miscellaneous aggregate shall conform to the requirements of Article M.02.02. Admixtures and surface protective materials used to prevent the gravel from freezing must meet the approval of the Engineer.

2.14.03—Construction Methods:

After all excavation has been completed, gravel or reclaimed miscellaneous aggregate shall be deposited in layers not exceeding 8 inches (200 millimeters) in depth over the areas. In exceptional cases, the Engineer may permit the first layer to be thicker than 8 inches (200 millimeters). Each layer shall be leveled off by the use of blade graders or bulldozers with adequate power for the work involved. The entire area of each layer shall be compacted by use of vibratory, pneumatic-tired or tread-type compaction equipment approved by the Engineer. Compaction shall be continued until the dry density over the entire area of each layer is not less than 95% of the dry density achieved by AASHTO T180, Method D. If a layer is formed from reclaimed miscellaneous aggregate containing bituminous concrete, the wet density after compaction on this layer shall not be less than 95% of the wet density for that compacted granular fill when tested in accordance with AASHTO T180, Method D.

Each layer of compacted granular fill shall be compacted at optimum moisture content. No subsequent layer shall be placed until the specified compaction is obtained for the previous layer.

In this test, material retained on the 3/4-inch (19-millimeter) sieve shall be replaced with material retained on the No. 4 (4.75-millimeter) sieve, as noted as an option in the specifications for this testing.

The embankment adjacent to the compacted granular fill shall be placed simultaneously with the compacted granular fill, and at no time shall there be a difference of more than 2 feet (600 millimeters) in elevation of the two classes of material. The embankment material to be placed simultaneously with the compacted granular fill shall extend at least 20 feet (6 meters) in every direction beyond the limits of the compacted granular fill, except that where a narrower width is shown on the plans, such narrower width of material shall be placed as prescribed above.

SECTION 2.16 PREVIOUS STRUCTURE BACKFILL

2.16.01—Description:

Pervious structure backfill shall include the furnishing, placing, and compaction of pervious material adjacent to structures.

2.16.02—Materials:

Pervious structure backfill shall conform to the requirements of Article M.02.05.

2.16.03—Construction Methods:

Pervious structure backfill shall be placed adjacent to abutments, retaining walls, box culverts, and elsewhere as called for. It shall be placed above a plane extending on a 2 to 1 slope from the upper edge of the footing to the top of the embankment, or as shown on the plans. Where the face of undisturbed material is above or beneath this slope plane, the amount of pervious structure backfill shall be decreased or increased accordingly, if ordered by the Engineer.

In filling behind abutments, retaining walls, box culverts, or other structures, the fill is placed against undisturbed material, or against compacted embankments having a length in a direction at right angles to the abutment wall or culvert not less than twice the height of the structure against which the fill is placed. The slope of the embankment on which the pervious structure backfill is to be placed shall be plowed deeply or cut into steps before and during the placing of pervious structure backfill so both types of material will be thoroughly bonded and compacted.

Each layer of pervious structure of backfill shall be spread to a thickness not exceeding 6 inches (150 millimeters) in depth after compaction and shall be thoroughly compacted as directed by the engineer by the use of power rollers or other motorized vehicular equipment, by tamping with mechanical rammers or vibrators, or by pneumatic tampers. Any equipment not principally manufactured for compaction purposes and equipment which is not in proper working order in all respects shall not be used within the area described above.

Special attention shall be given to compaction in places close to walls where motorized vehicular equipment cannot reach. Within 3 feet (1 meter) of the back face of walls and within a greater distance at angle points of walls, each layer of pervious structure backfill shall be compacted by mechanical rammers, vibrators, or pneumatic tampers.

The dry density of each layer of pervious structure backfill formed from broken or crushed stone, broken or crushed gravel or reclaimed miscellaneous aggregate free of bituminous concrete shall have a dry density after compaction that is no less than 100% of the dry density for that material when tested in accordance with AASHTO T180, Method D. If a layer formed from reclaimed miscellaneous aggregate containing bituminous concrete is placed as pervious structure backfill, the wet density of this layer after compaction shall not be less than 100 percent of the wet density for that material when tested in accordance with AASHTO T180, Method D.

In this test, material retained on the 3/4-inch (19-millimeter) sieve shall be replaced with material retained on the No. 4 (4.75-millimeter) sieve, as noted as an option in the specifications for this test.

Each layer of the pervious structure backfill shall be compacted at optimum moisture content. No subsequent layer shall be placed until the specified compaction is obtained for the previous layer.

Where weep holes are installed, bagged stone shall be placed around the inlet end of each weep hole, to prevent movement of the pervious material into the weep hole.

SECTION 2.18 SEDIMENT CONTROL BALES

2.18.01—Description:

This work shall consist of furnishing, placing, maintaining and removing hay bales for sedimentation control as shown on the plans or as directed by the Engineer. Maintaining shall include the clean-out of accumulated sediment.

Refer to Division 01, High Performance Buildings Requirements Section 018113.13 for credit 16a-38k-3(h).

The above listed HPB credit is related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2.18.02—Materials:

Bales shall be made of hay with 40 pounds minimum weight (18 kilograms minimum mass) and 120 pounds maximum weight (54 kilograms maximum mass). Wood stakes shall be a minimum of 1 inch x 1 inch (25 millimeters x 25 millimeters) nominal size by a minimum of 3 feet (1.0 meters) long.

2.18.03—Construction Methods:

Bales shall be placed by the Contractor in locations shown on the plans or as directed by the Engineer. They shall be placed lengthwise with ends of adjacent bales tightly abutting one another. All bales shall be installed so that bindings are oriented around the sides, rather than along the tops and bottoms. Bales shall be entrenched 4 inches (100 millimeters) and backfilled, with the backfilled soil placed toward the potential silt source. They shall be held in place by two wooden stakes in each bale, with loose straw inserted in voids between the bales. Bales shall be maintained or replaced until they are no longer necessary for the purpose intended or are ordered removed by the Engineer. Clean out of accumulated sediment shall be accomplished when one-half of the original height of the bales as installed becomes filled with sediment or as directed by the Engineer.

SECTION 2.19 SEDIMENT CONTROL SYSTEMS

2.19.01—Description:

This work shall consist of furnishing, placing, maintaining and removing sedimentation control systems as shown on the plans or as directed by the Engineer. Maintaining shall include the clean out of accumulated sediment.

Refer to Division 01, High Performance Buildings Requirements Section 018113.13 for credit 16a-38k-3(h).

The above listed HPB credit is related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2.19.02—Materials:

Hay bales shall conform to Article 300000-2.18.02. Geotextile shall conform to Section 300000-7.55 and M.08.

2.19.03—Construction Methods:

Sedimentation Control Systems shall be installed by the Contractor in locations shown on the plans or as directed by the Engineer. When hay bales are used they shall be installed as specified in Article 300000-2.18.03. Geotextile sedimentation control systems may consist of either a prefabricated geotextile fence or a geotextile fence assembled by the Contractor in the field. Geotextile sedimentation control systems shall be installed so that the bottom 6 inches (150 millimeters) of the fabric is buried by either trenching or by laying the 6-inch (150-millimeter) section horizontally on the ground and burying by ramping the soil up to the control fence. All geotextile fences shall be at least 30 inches (760 millimeters) in exposed height as installed, with not less than a 2-degree and not more than a 20- degree inclination toward the potential silt source. Hardwood posts shall have a minimum cross-section size of at least 1.5 inches x 1.5 inches (38 millimeters x 38 millimeters) and a minimum length of 42 inches (1.1 meters). Steel posts shall be at least 0.5 pounds per linear foot (0.75 kilograms per meter) with a minimum length of 48 inches (1.2 meters). Spacing between posts shall not exceed 10 feet (3 meters), and all posts shall be driven a minimum of 12 inches (304 millimeters) into the ground. When joints between sections of geotextile sedimentation control systems are necessary, geotextile shall be spliced together only at a support post, with a minimum 6-inch (150-millimeter) overlap, and securely sealed.

The Contractor may use brush as a backing for the geotextile by piling the brush 2 to 3 feet (600 millimeters to 900 millimeters) high and then attaching the geotextile to the brush and burying the bottom 6 inches (150 millimeters) of geotextile as in the previous fence method.

The installations shall be maintained or replaced until they are no longer necessary for the purpose intended or are ordered removed by the Engineer. Clean out of accumulated sediment shall be accomplished when one-half of the original height of the sedimentation control system, as installed, becomes filled with sediment or as ordered by the Engineer.

The geotextile fence systems will be completely removed from the project at the completion of the project, unless specifically authorized by the Engineer to be left in place.

Hay bale systems will be allowed to remain in toe of slope areas unless ordered removed by the Engineer. Unless a specific type of sedimentation control system is indicated on the plans or directed by the Engineer, the type of system will be at the Contractor's option.

SECTION 3.04 PROCESSED AGGREGATE BASE

3.04.01--Description:

The base shall consist of a foundation constructed on the prepared subbase or subgrade in accordance with these specifications and in conformity with the lines, grades, compacted thickness and typical cross-section as shown on the plans.

3.04.02--Materials:

All materials for this work shall conform to the requirements of Article M.05.01.

3.04.03--Construction Methods:

Only one type of coarse aggregate shall be used on a project unless otherwise permitted by the Engineer.

Prior to placing the processed aggregate base, the prepared subbase or subgrade shall be maintained true to line and grade, for a minimum distance of 200 feet (60 meters) in advance of the work. None of the aggregate courses shall be placed more than 500 feet (150 meters) ahead of the compaction and binding operation on that particular course.

The processed aggregate base shall be spread uniformly by a method approved by the Engineer. The thickness of each course shall not be more than 4 inches (100 millimeters) after compaction, unless otherwise ordered.

After the aggregate is spread, it shall be thoroughly compacted and bound by use of equipment specifically manufactured for that purpose. Rollers shall deliver a ground pressure of not less than 300 pounds per lineal inch (52.5 newtons/millimeter) of contact width and shall have a weight (mass) not less than 10 tons (9100 kilograms). Vibratory units shall have a static weight (mass) of not less than 4 tons (3650 kilograms). Water may be used during the compaction and binding operation and shall be applied from an approved watering device. The compacting and binding operation shall begin at the outside edges, overlapping the shoulders for a distance of not less than 6 inches (150 millimeters) and progress towards the middle, parallel with the centerline of the pavement. The work shall cover the entire surface of the course with uniform overlapping of each preceding track or pass. Areas of super-elevation and special cross slope shall be compacted by beginning at the lowest edge and proceeding towards the higher edge, unless otherwise directed by the Engineer. The compacting and binding operation shall be continued until the voids in the aggregates have been reduced to provide a firm and uniform surface satisfactory to the Engineer. The amount of compactive effort shall in no case shall be less than four (4) complete passes of the compacting and binding operations. All aggregate shall be completely compacted and bound at the end of each day’s work or when traffic is to be permitted to operate on the road. The dry density of each layer of processed aggregate base after compaction shall not be less than 95 percent of the dry density for that material when tested in accordance with AASHTO T180, Method D.

Should the subbase or subgrade material become churned up or mixed with the processed aggregate base at any time, the Contractor shall, without additional compensation remove the mixture. The Contractor shall add new subbase material, if required, and reshape and recompact the subbase in accordance with the requirements of Article 300000-2.12.03. New aggregate material shall be added, compacted and bound, as hereinbefore specified, to match the surrounding surface.

Any surface irregularities which develop during, or after work on each course, shall be corrected by loosening material already in place and removing or adding aggregate as required. The entire area, including

the surrounding surface, shall be re-compacted and rebound until it is brought to a firm and uniform surface satisfactory to the Engineer.

SECTION 4.01 CONCRETE PAVEMENT

4.01.01—Description:

This pavement shall consist of Portland cement concrete, with or without reinforcement, in conformity with the lines, grades, thickness, and typical cross section as shown on the plans.

Refer to Division 01, High Performance Buildings Requirements Section 018113.13 for credit 16a-38k-4(d)9 and 16a-38k-4(d)11.

The above listed HPB credit is related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

4.01.02—Materials:

The materials for this work shall conform to the requirements for concrete pavement under M.03. Reinforcing steel shall conform to M.06.01.

4.01.03—Construction Methods:

A. Composition: The composition of the concrete shall be in accordance with the requirements of Section M.03 — Portland Cement Concrete, as well as the applicable sections of ACI 211 and ACI 318. The Contractor shall submit all concrete mix designs to the Division of Materials Testing for review and approval prior to production of the design. At the option of the Contractor, other approved cementitious material may be used to replace a portion of the required Portland cement in accordance with the requirements of Section M.03.

Since the yield is theoretical, the Department will not be responsible for any variation in yield as actually obtained on the job. Consistency of the concrete shall be uniformly maintained within the allowable range of slump. The slump shall be measured in accordance with AASHTO Method T119.

The concrete shall be air-entrained and shall contain an air content of 6% ± 1 1/2% at the time the concrete is deposited on the grade. Air entrainment shall be obtained by use of an approved air-entraining admixture added to the concrete at the time of mixing.

The air content of the plastic concrete shall be determined in accordance with AASHTO Method T152, Pressure Method. No alternative method will be accepted.

The temperature of the concrete at the time of placement shall not be less than 60 F (15.5 C) or greater than 90 F (32 C). For pumped concrete, the temperature shall be determined at the placement end of the pump line. The temperature of the concrete shall be determined in accordance with ASTM C1064.

No change in the source or character of the materials shall be made without due notice to the Engineer, and no new material shall be used until the Engineer has accepted such materials and has designated new proportions based upon tests of new trial mixes as provided hereinbefore.

B. Material Storage: Each cementitious material shall be stored in a separate, weatherproof compartment clearly identified.

Sites for aggregate stockpiles shall be reasonably smooth, hard, well-drained areas. Aggregates from different sources and of different gradation shall not be stockpiled together.

Aggregates shall be handled from stockpiles or other sources to the batching plant in such manner as to minimize segregation of the material. Aggregates that have become segregated, or mixed with earth or foreign material, shall not be used.

C. Batching Plant and Equipment: Equipment necessary for handling materials and performing all parts of the work shall be approved by the Engineer as to design, capacity, and mechanical condition. The equipment shall be at the job site sufficiently ahead of the start of construction operations to be examined thoroughly and approved. After approval, the Contractor shall maintain all equipment and tools in a satisfactory working condition until the completion of the work.

1. General: The batching plant shall include storage bins, weighing (mass determining) hoppers, scales, and metering equipment as required. A separate scale for cementitious materials shall be used.

2. Scales: Scales for measuring concrete ingredients may be horizontal beam-type, springless scales or electronic devices and shall conform to the applicable requirements of the NIST Handbook 44 except as otherwise specified herein.

Weight (mass)-indicating devices shall be in full view and near enough to be read accurately by the operator while charging the hoppers. The operator shall have convenient access to all controls.

When beam-type scales are used, a "tell-tale" dial shall be provided for indicating to the operator that the required load in the weighing (measuring) hopper is being approached. A device on measuring beams shall indicate critical positions clearly. The dial faces of springless dial scales shall be of a material not affected by moisture. The graduated dial scale shall be provided with the required number of suitable markers in front of the dial face which may be set at the required positions of the indicator for predetermined weights (masses).

Methods for weighing (measuring) (electric, hydraulic, load cells, etc.) other than the methods noted above, which meet the required weighing (measuring) tolerances may be approved by the Engineer.

3. Ten certified standard 50-pound weights (22.7-kilogram masses) shall be available at the batching plant for checking the accuracy of the scales. Weights (masses) shall be certified by the Department of Consumer Protection.

4. The Contractor shall notify the Engineer 2 days in advance that the scales are in proper adjustment and ready to be sealed. The bins shall be filled sufficiently to perform the tests required, and the Contractor shall have available a man skilled in making any adjustments necessary to seal the scales. The Engineer may request that the scales, after checking with a 500-pound weight (227-kilogram mass), be resealed at any time, if in his opinion the scales are out of adjustment. Scales shall be "sealed" at the expense of the Contractor by the "Sealer of Weights and Measures." Scales shall be inspected and sealed at least once every 12 months.

5. Automation: All plants shall be equipped with an approved automatic cycling and monitoring system installed as part of the batching equipment, unless otherwise indicated in the plans or specifications or in the opinion of the Engineer, job conditions warrant otherwise. The system shall include equipment for accurately proportioning the various components of the mixture by weight (mass).

Admixtures and water may be measured volumetrically. The automatic proportioning system shall be capable of consistently delivering each constituent within the tolerances specified.

There shall be auxiliary interlock cutoff circuits to interrupt and stop the automatic batching operations whenever an error exceeding the acceptable tolerance occurs in proportioning for all material components except water. Zero return tolerance shall be equal to that of the delivery tolerances for the minimum batch size.

When the aggregate sizes are weighed (When the masses of the aggregate sizes are taken) cumulatively, the tolerance for each bin draw weight (mass) shall be based on the total aggregate batch weight (mass). If aggregate sizes are weighed (measured) separately, the percentage shall apply to each scale weight (mass). When the other approved cementitious material is weighed (measured) cumulatively with the cement, the other approved cementitious material shall be last in the weighing (measuring) sequence, and the batching delivery tolerance for each material draw weight (mass) shall be based upon the total weight (mass) of cement plus other approved cementitious material.

The electrical circuits used to check delivery tolerances may be set at any span within the full allowable tolerance for any approved batch size. For plants not equipped to automatically adjust tolerances, the tolerance span shall be set for the minimum approved batch size whenever varying batch sizes are being produced.

Batching Delivery Tolerances:
Cementitious materials ± 1% (by weight (mass))
Aggregate ± 2% (by weight (mass))
Water ± 1% (by weight (mass) or volume—applies
at central mix plants only)

Admixtures ± 3% (by weight (mass) or volume—or ± 1 ounce (30 milliliters), whichever is greater)

The automatic proportioning system shall be capable of rapidly selecting and proportioning at least 3 classes of concrete. In addition, the system shall have the capability of batching materials in at least 2 batch sizes. These provisions will not be required for project-site plants batching only 1 class of concrete for a project. The system shall be interlocked during the batching of cement and aggregates so that:

No inlet gate can be opened while the weigh (measuring) hopper discharge gate is open.

No weigh (measuring) hopper discharge gates can be opened

(a) While the hopper is being filled.
(b) Until the full batch weight (mass) is within the delivery tolerance.

No new batch can be measured until the hopper is entirely empty of the previous batch and the scale has returned to "zero."

When the manual batching is permitted, the constituents shall be batched within the indicated delivery tolerances for the automatic proportioning system.

6. Slump Control: Controls shall be provided so that the batch plant operator can produce concrete of the slump required by the paving operation. Included shall be a moisture compensation system, a slumpmeter, and a slump-adjust control. The moisture compensation control can be automatically or manually set for the amount of moisture in the fine aggregate. A moisture compensation system shall compute the adjustment to the water and the fine aggregate components of the concrete to be measured by the automatic batching plant. The actual amounts of each material batched shall be recorded in the manner required elsewhere in these specifications.

7. Batch Recording Instruments: All concrete batching plants shall be equipped with digital or graphical recording instruments approved by the Engineer. The recording instruments shall be designed to record the quantities of each aggregate component, cement, other approved cementitious materials (when used), water (at central mix batch plants), and the presence of admixture for each batch of concrete produced. All records of batches shall show the batch number, the day, the month, the year, and the time of day to the nearest minute for each batch. This information shall be imprinted on the record so that each batch may be permanently identified. The Department shall be provided with a clear and legible copy of all batch records for concrete supplied to the Department.

Cement, other approved cementitious material, and aggregate component weights (masses) shall be recorded separately. Water at central mix plants may be recorded by weight (mass) or volume. When a digital tape or ticket recorder is used, weights (masses) shall be recorded as indicated on the batching scale or meter within an accuracy of ± 1 scale or meter graduation. The minimum resolution of digital recorders shall be equivalent to the minimum graduation on the scale meter, unless otherwise approved by the Engineer.

If graphical recorders or multiple recorders, either digital or graphical, are used, they shall be subject to the approval of the Engineer.

The control system shall include a mixer timer which is interlocked with the mixer discharge control, such that the concrete will be mixed for the approved time.

If any of the above equipment fails to operate satisfactorily, the Engineer shall be notified immediately, and the Engineer will assign an inspector to the plant to monitor plant operation. Only if job conditions warrant, the Engineer may allow concrete to be delivered to the project without an inspector at the plant to monitor plant operation. When the plant is permitted to operate by manual control during periods of automatic equipment failure, a manually written ticket providing all the specified batch information required from the automatic "batch recording instrument" will be required for each batch supplied to the Department.

The plant shall be returned to compliance with these specifications within 2 working days of the equipment failure. After that period, concrete will not be accepted by the Department. No costs will be incurred by the Department for any production loss, or delays due to the enforcement of this requirement.

D. Mixing Equipment:

1. General: Concrete may be mixed at the site of construction or at a central point. Truck-mixed or transit-mixed concrete may be used with the permission of the Engineer for limited amounts of pavement and for other exceptional cases. Each mixer shall have attached in a prominent place a manufacturer's plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

2. Mixers at site of construction or at a central point: Mixing shall be in an approved mixer capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform mass within the specified mixing period, and of discharging the mixture without segregation.

3. Mixing time: The mixing time requirements shall be in accordance with the recommendations of the manufacturer of the mixer. If a mixing time of less than 60 seconds is recommended, the Contractor shall furnish test data acceptable to the Engineer, verifying that the reduced mixing time will produce uniform concrete conforming to the provisions of AASHTO M157.

The mixer shall be operated at a drum speed as shown on the manufacturer's name plate on the approved mixer. Any concrete mixed less than the specified time shall be discarded and disposed of by the Contractor at his expense. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity in cubic feet (meters), as shown on the manufacturer's standard rating plate on the mixer, except that an overload up to 10% above the mixer's nominal capacity may be permitted provided concrete test data for strength and uniform consistency are satisfactory, and provided no spillage of concrete takes place.

E. Hauling Units:

1. Truck mixers and truck agitators: Truck mixers used for mixing and hauling concrete, and truck agitators used for hauling central-mixed concrete, shall conform to the requirements of Article 300000-6.01.03-3, "Transportation and Delivery of Concrete."

2. Nonagitator trucks: Bodies of non-agitating hauling equipment for concrete shall be smooth, mortar-tight, non-aluminum metal containers and shall be capable of discharging the concrete at a satisfactory controlled rate without segregation. Covers shall be provided when needed for protection.

3. Hauling central mix concrete: Mixed concrete from the central mixing plant shall be transported in truck mixers, truck agitators, or non-agitating trucks. The time elapsing from the time water is added to the mix until the concrete is deposited in place at the site of the work shall not exceed 30 minutes when the concrete is hauled in non-agitating trucks, nor 60 minutes when hauled in truck mixers or truck agitators, except that in hot weather or under other conditions contributing to quick stiffening of concrete, the maximum allowable time may be reduced by the Engineer.

4. Addition of water in truck mixers: When mixed concrete is transported in approved truck mixers, water may be added to the concrete at the delivery site, with the permission of the Engineer, to achieve the required slump, provided the specified water-cement ratio for the concrete is not exceeded and the concrete is mixed for at least thirty additional revolutions at mixing speed to ensure thorough mixing of the water into the concrete. Further addition of water to the concrete after the initial slump adjustment will not be permitted.

F. Placing Concrete: All forms, slip form pavers, and other equipment used in the placing, curing, and finishing of concrete shall be of a design acceptable to the Engineer.

1. Forms: Forms shall be set by the Contractor to true line and grade.

The specified grade shall be set and compacted prior to the setting of forms. Conditioning of Subgrade or Base Course: The subgrade or base course shall be brought to proper cross section. High areas shall be trimmed to proper elevation. Low areas shall be filled and compacted to a condition similar to that of surrounding grade. The finished grades shall be maintained in a smooth and compacted condition until the pavement is placed.

2. Slip Form Paving: When slip form paving, the subgrade, or the surface of the subbase over which the tracks of the slip form paver will travel shall not vary more than ± 3/16 inch (+5 millimeters) from the grade established by the Engineer.

Except when the Contractor elects to place reinforcement in a two-layer procedure, the slip form paving equipment shall spread, consolidate, screed and float finish the freshly placed concrete in 1 pass in a manner such that a minimum of hand floating will be required. The operations of depositing, spreading, consolidating and finishing shall be such that, insofar as possible, continuous operation of the paver will be maintained. Frequent starting and stopping of the paver should be kept to a minimum.

3. Placement: Where concrete is to be placed adjoining a previously constructed pavement, and hauling units and mechanical equipment will be operated upon that previously constructed pavement, that pavement shall have attained the strength specified for opening the pavement to vehicular traffic. If only finishing equipment is carried on the existing pavement, paving in adjoining lanes may be permitted after the concrete is tested in accordance with Article 300000-4.01.03(I) and has attained a modulus of rupture of 400 psi (2800 kilopascals).

Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and on both sides of all joint assemblies, by means of vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, or a side form. In no case shall the vibrator be operated longer than 5 seconds in any one location.

Concrete shall be deposited as close to expansion and contraction joints as possible without disturbing them, but shall not be dumped from the discharge bucket or hopper on to a joint assembly unless the hopper is well centered on the joint assembly.

Should any concrete materials fall on or be worked into the surface of a completed slab, they shall be removed immediately by approved methods.

In order that the concrete may be properly protected against the effects of rain before the concrete is sufficiently hardened, the Contractor will be required to have available at all times materials for the protection of the edges and surface of the unhardened concrete.

4. Placing Reinforcement: If mechanical means are used to place pavement reinforcement and/or pavement fabric, the mechanical placement equipment shall be capable of positioning the reinforcement or fabric within the tolerances specified.

When reinforced concrete pavement is placed in 2 layers, the entire width of the bottom layer shall be struck off and consolidated to such length and depth that the sheet of fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall be placed directly upon the concrete, after which the top layer of the concrete shall be placed, struck off and screeded.

Any portion of the bottom layer of concrete which has been placed more than 45 minutes without being covered with a top layer shall be removed and replaced with freshly mixed concrete at the Contractor's expense. When reinforced concrete is placed in 1 layer, the reinforcement may be positioned in advance of concrete placement or it may be laced in plastic concrete after spreading, by mechanical or vibratory means.

Reinforcing steel shall be free from dirt, oil, paint, grease, mill scale, and loose or thick rust, which could impair bond of the steel with the concrete.

5. Finishing:

(a) Sequence: The sequence of operations shall be the strike-off and consolidation floating and removal of laitance, and final surface finish. Work bridges or other devices necessary to provide access to the pavement surface for the purpose of finishing, straight-edging, and making corrections as hereinafter specified, shall be provided by the Contractor.

In general, the addition of superficial water to the surface of the concrete to assist in finishing operations will not be permitted. If the application of water to the surfaces is permitted, it shall be applied as a fog spray by means of approved spray equipment.

(b) Finishing at Joints: The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material, under and around all load transfer devices, joint assembly units, and other features designed to extend into the pavement. Concrete adjacent to joints shall be mechanically vibrated.

(c) Hand Finishing: Unless otherwise specified, hand finishing methods will not be permitted except under the following conditions:

i. In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade when the breakdown occurs.

ii. Narrow widths or areas of irregular dimensions where operations of the mechanical equipment is impractical may be finished by hand methods.

Concrete, as soon as placed, shall be struck off and screeded. An approved portable screed shall be used.

A second screed shall be provided for striking off the bottom layer of concrete if reinforcement is used.

(d) Floating: After the concrete has been struck off and consolidated it shall be further smoothed, trued, and consolidated by means of a float.

(e) Final Finish: When all irregularities have been removed, and the edges of the slabs and joints given their initial edging, the pavement shall be subjected to the following 2-stage texturing treatment:

i. Dragging with Burlap: The burlap shall be at least 3 feet (1.0 meter) wide and a length of 2 feet (0.6 meter) greater than the width of the lane or lanes being placed. The burlap shall not have frayed edges and shall be kept wet and clean of accumulations of dried concrete particles or other foreign materials, which might leave distinctive undesirable marks. The burlap shall be drawn longitudinally along the surface in a slow manner so as to have an even texture. When not in use, the burlap shall not be allowed to rest on the pavement.

ii. Texturing with Tines: As soon as possible, after the pavement surface has been dragged with the burlap, mechanical equipment shall be used to texture the surface with deep transverse grooves.

The equipment shall consist of a self-propelled device capable of applying a textured finish transverse to the centerline of the pavement. The texturing shall be done with tines 0.03 inch (0.75 millimeter) thick, 0.08 inch (2.0 millimeters) wide, and 4 to 6 inches (100.0 millimeters to 150.0 millimeters) in length with an average spacing of 1/2 inch (12.0 millimeters) on centers.

The transverse grooving shall be performed when the condition of the concrete is optimum. This condition will prevail when the grooves can be formed to a depth of 1/8 inch (3.2 millimeters) to 1/4 inch (6.4 millimeters) with relative ease and without the walls of the grooves closing back in on each other. Other adjustments to the tining procedure may be permitted by the engineer to obtain grooves of the proper width and depth.

The tined grooving shall extend from edge to edge of the pavement, and shall be perpendicular to the centerline of the pavement. The tining mechanism shall be aligned so as to prevent overlapping of grooves in

any two successive passes. The depth of the grooves formed in the surface by the tines shall be checked randomly with a tire tread depth-measuring gage furnished by the Contractor to ensure compliance with the required limits of 1/8 inch to 1/4 inch (3.2 millimeters to 6.4 millimeters). The original surface of the concrete shall serve as the datum for the depth measurements.

(f) Edging at Forms and Joints: After the final finish, but before the concrete has taken its initial set, the edges of the pavement along each side of each slab, and on each side of transverse expansion joints, formed joints, transverse construction joints, and emergency construction joints shall be worked with an approved tool and rounded to the radius required by the plans.

A well-defined and continuous radius shall be produced and a smooth, dense mortar finish obtained. The surface of the slab shall not be unduly disturbed by tilting the tool during use.

At all joints, any tool marks appearing on the slab adjacent to the joints shall be eliminated by brooming the surface. In doing this, the rounding of the corner of the slab shall not be disturbed. All concrete on top of the joint filler shall be completely removed. All joints shall be tested with a straight edge before the concrete has set, and correction made if one side of the joint is higher than the other or if they are higher or lower than the adjacent slabs.

6. Joints: Joints shall be constructed of the type and dimensions, and at the locations required by the plans or specifications. All joints shall be protected from the intrusion of injurious foreign material until sealed.

(a) Longitudinal Joint: Deformed steel tie bars of specified length, size, spacing and material shall be placed perpendicular to the longitudinal joints; they shall be placed by approved mechanical equipment or rigidly secured by chairs or other approved supports to prevent displacement. Tie bars shall be coated with epoxy conforming to AASHTO M284. When shown on the plans and when adjacent lanes of pavement are constructed, steel side forms shall be used which will form a keyway along the construction joint. Tie bars may be bent at right angles against the form of the first lane constructed and straightened into final position before the concrete of the adjacent lane is placed, or in lieu of bent tie bars, approved two-piece connectors may be used.

Longitudinal formed joints shall consist of a groove or cleft, extending downward from, and normal to, the surface of the pavement. These joints shall be effected or formed by an approved mechanically or manually operated device to the dimensions and line indicated on the plans and while the concrete is in a plastic state. The groove, or cleft, shall be filled with either a pre-molded strip or poured material.

The longitudinal joint, however formed, shall be continuous. There shall be no gaps in either transverse or longitudinal joints at the intersection of the joints.

Longitudinal sawed joints shall be cut by means of approved concrete saws to the depth, width and line shown on the plans. Suitable guidelines or devices shall be used to assure cutting the longitudinal joint on the true line as shown on the plans. The longitudinal joint shall be sawed within 36 hours of placement and before any other equipment or vehicles are allowed on the pavement. The sawed area shall be thoroughly cleaned and the joint shall immediately be filled with sealer.

(b) Transverse Expansion Joints: The expansion joint fillers shall be continuous from edge to edge, shaped to the subbase and to the keyway along the edge. Preformed joint filler shall be furnished in lengths equal to the pavement width or equal to the width of one lane. Damaged or repaired joint filler shall not be used unless approved by the Engineer.

The expansion joint filler shall be held in a vertical position. An approved installing bar, or other device shall be used if required to secure preformed expansion joint filler at the proper grade and alignment during placing and finishing of the concrete. Finished joints shall not deviate more than 1/4 inch (6.4 millimeters) in the horizontal alignment from a straight line. If joint fillers are assembled in sections, there shall be no offsets between adjacent units. No plugs of concrete shall be permitted anywhere within the expansion space.

(c) Transverse Contraction Joints: Transverse con-traction joints shall consist of planes and of weakness created by forming or cutting grooves in the surface of the pavement and, when shown on the plans, shall include transfer assemblies.

i. Formed grooves shall be made by depressing an approved tool or device into the plastic concrete. The tool or device shall remain in place until the concrete has attained its initial set and shall then be removed without disturbing the adjacent concrete, unless the device is designed to remain in the joint.

ii. Sawed contraction joints shall be created by sawing grooves in the surface of the pavements of the dimensions and at the spacing and lines shown on the plans with an approved concrete saw. After each joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly cleaned. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling, usually 4 to 24 hours. All joints shall be sawed before uncontrolled shrinkage cracking takes place. If necessary, the sawing operations shall be carried on both during the day and night, regardless of weather conditions. The sawing of any joint shall be omitted if a crack occurs at or near the joint location prior to the time of sawing. Sawing shall be discontinued when a crack develops ahead of the saw. In general, all joints should be sawed in sequence. If extreme conditions exist, which make it impractical to prevent erratic cracking by early sawing, the contraction joint groove shall be formed prior to initial set of concrete as provided above. The Engineer will review and approve procedures and methods to correct random cracking.

iii. Transverse formed contraction joints shall comply with the requirements for the longitudinal formed joint.

(d) Transverse Construction Joints: Transverse construction joints shall be constructed when there is an interruption of more than 30 minutes in the concreting operations. No transverse joint shall be constructed within 10 feet (3.0 meters) of an expansion joint, contraction joint, or plane of weakness. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 10 feet (3.0 meters) long, the excess concrete back to the last preceding joint shall be removed and disposed of as directed.

(e) Load Transfer Devices: Load transfer devices shall conform to the requirement of Subarticle M.03.08.

(f) Sealing Joints: Joints shall be sealed as soon after completion of the curing period as feasible and before the pavement is opened to traffic, including the Contractor's equipment. Just prior to sealing, each joint shall be thoroughly cleaned of all foreign material, including membrane curing compound and the joint-faces shall be clean and surface dry when the seal is applied.

The sealing material shall be applied to each joint opening to conform to the details shown on the plans or as directed by the Engineer. Material for seal applied hot shall be stirred during heating so that localized overheating does not occur. The pouring shall be done in such a manner that the material will not be spilled on the exposed surfaces of the concrete. The use of sand or similar material as a cover for the seal will not be permitted. Poured joint-sealing material shall not be placed when the air temperature in the shade is less than 50oF (10°C), unless approved by the Engineer.

Preformed elastomeric gaskets for sealing joints shall be of the cross sectional dimensions shown on the plans. Seals shall be installed by suitable tools, without elongation, and secured in place with an approved lubricant adhesive which shall cover both sides of the concrete joints. The seals shall be installed in a compressed condition and shall at time of placement be below the level of the pavement surface by approximately 1/4 inch (6.4 millimeters). The seals shall be in one piece for the full width of each transverse joint.

7. Curing: Immediately after the finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be covered and cured in accordance with one of the methods below. Liquid Membrane - Forming Cure is the preferred method of curing. Moist curing and cover sheet curing must be approved by the Engineer prior to paving operations.

In all cases in which curing requires the use of water, the curing shall have prior right to all water supply or supplies. Failure to use, or lack of water to adequately take care of both curing and other requirements, shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than 30 minutes between stages of curing or during the curing period.

When concrete is being placed and the air temperature may be expected to drop below 35oF (2°C) a sufficient supply of straw, hay, grass, or other suitable blanketing material shall be provided along the work and any time the temperature may be expected to reach the freezing point during the day or night, the material so provided shall be spread over the pavement to a sufficient depth to prevent freezing of the concrete. During the period of time such protection, the Contractor shall be responsible for the quality and strength of the concrete placed during cold weather, and any concrete injured by frost action shall be removed and replaced at the Contractor's expense.

(a) Liquid Membrane-Forming Cure: The liquid curing compound shall conform to Subarticle M.03.04-3. When resin-based curing compound is used, it shall be applied following the final finishing immediately after the disappearance of the water sheen and before any surface checking or marked dehydration of the concrete occurs.

When water-soluble, linseed oil-based compound is used, it shall be applied immediately following the final finishing.

The compound shall be applied by an approved self-propelled mechanical pressured sprayer delivering a fine, even spray with uniform coverage. This equipment shall be provided with a suitable device for adequate agitation of the compound to prevent settlement. For the sides of concrete pavement exposed after removal of the forms and for areas where the use of self-propelled equipment is not practical, approved hand-held spray bars delivering a fine, even spray may be used; and the compound shall be drawn from a tank equipped with an approved device to prevent settlement or by a method which will prevent settlement.

If the compound is applied in two applications, the second application shall follow the first application within 30 minutes. The compound shall be applied in a continuous, uniform film at not less than one gallon for 150 square feet (one liter for 3.7 square meters).

If rain falls on the newly coated pavement before the film has dried sufficiently to resist damage, or if the film is damaged in any other way, the Contractor will be required to apply a new coat of material to the affected areas equal in curing value to that specified for the original coat. The treated surface shall be protected by the Contractor from injury for a period of at least 7 days. All traffic, either foot or otherwise, will be considered as injurious to the film of the applied compound.

The Contractor shall have on the project sufficient approved cover sheet or cotton mats for the protection of the pavement in case of rain or breakdown of the spray equipment. The cotton mats shall be maintained in a wet condition during the period of use, as elsewhere herein specified.

Transverse joints shall be protected from the compound by means or methods approved by the Engineer.

(b) Moist Curing: After the surface of the concrete has been given its final finish, it shall be protected by covering it with moist mats of the size and quality specified in Article M.03.04-2. These mats shall be laid longitudinally over the surface of the finished pavement by unrolling from the supported roll so as not to bring an excessive weight (mass) upon or to mar the new surface of the pavement. After placing, these mats shall be saturated and kept saturated for a period of 7 days, at the end of which time they may be removed, and no further wetting or artificial curing will be required.

(c) Cover Sheet Curing: As soon as practicable after the finishing operations, paper or polyethylene cover sheets conforming to Article M.03.04-4. shall be placed in such a manner that the surface of the concrete shall not be marred. The adjoining covers shall overlap at least 18 inches (500 meters), and the lap shall be securely fastened down to form a closed joint. On removal of the forms, the edges shall be covered down to the bottom of the pavement. The cover sheets shall remain in place for a period of 7 days. In the event that hair-checking develops before the cover can be placed, the procedure set forth shall be modified at the direction of the Engineer. Moist curing mats shall then be used for the initial 24 hours of the curing period, and the cover sheets placed for the remainder of the curing period.

Before reusing paper or polyethylene covers, they shall be checked for holes or tears, and any such perforations shall be repaired. Covers which have become unserviceable will be rejected by the Engineer.

G. Protection of Pavement: The Contractor shall protect the pavement and its appurtenances against public traffic and traffic caused by his own employees and agents until the pavement is opened to traffic.

Any damage to the pavement occurring prior to the opening of the pavement to traffic by the State shall be repaired or the pavement replaced.

H. Riding Surface Tests:

1. Surface Test (Straightedge) and Corrections: As soon as the concrete has hardened sufficiently, the pavement surface shall be tested by the Contractor with an approved 10-foot (3-meter) straightedge placed both transversely and longitudinally to the centerline at sufficient intervals to check the surface profile. Areas showing high spots of more than 1/8 inch (3.2 millimeters), exclusive of tining corrugations, shall be marked by the Engineer and removed by the Contractor to an elevation where the area or spot will not show surface deviations in excess of 1/8 inch (3.2 millimeters) when tested with a 10-foot (3-meter) straightedge. Correction of surface irregularities and resulting surface finish shall conform to the requirements specified herein for mainline pavement.

I. Flexural Testing of Concrete: The flexural strength of the concrete pavement shall be monitored by the evaluation of compressive strength cylinders. The compressive strength specimens shall be cast and cured in the field in accordance with ASTM C 31 (AASHTO T 23). After proper curing, these cylinders shall be transported to the Division of Materials Testing for strength evaluation.

J. Opening to Traffic: Vehicular traffic shall be excluded from the pavement until sufficient curing has taken place. The pavement shall be opened to traffic with the attainment of a compressive strength of 3,500 psi (25 megapascals).

Any damage to the pavement from traffic or any other causes, occurring prior to acceptance of this contract, shall be repaired by the Contractor at his own expense.

If the Contractor wants to increase the early strength of the pavement in order to facilitate his plan for the paving sequence, he may substitute TYPE III Portland Cement, or use a concrete with a higher cement factor. The mix design for this concrete must be approved by the Engineer.

SECTION 5.06 RETAINING WALLS, ENDWALLS AND STEPS

5.06.01—Description:

Under this heading shall be included all concrete and masonry retaining walls, endwalls, steps and other miscellaneous structures. All such structures shall be built in the locations indicated or directed, conforming to the lines, grades, dimensions and details shown on the plans and in accordance with the provisions of these specifications for the various elements which constitute the completed structure.

Division 01, High Performance Buildings Requirements Section 018113.13 for credit 16a-38k-4(d)9 and 16a-38k-4(d)11.

The above listed HPB credit is related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

5.06.02—Materials:

The materials furnished and used in the work shall be those prescribed herein which constitute the completed structure.

Unless otherwise noted, concrete shall be Class "F" Concrete conforming to Article M.03.01, except that the concrete for steps and copings shall be Class "C" Concrete conforming to Article M.03.01.

The concrete shall be air-entrained and shall contain an air content of 6% ± 1 1/2% at the time the concrete is deposited. Air entrainment shall be obtained by use of an approved air-entraining admixture added to the concrete at the time of mixing.

5.06.03—Construction Methods:

All construction methods for endwalls, retaining walls, steps and other miscellaneous structures shall be in accordance with the detailed requirements prescribed for the construction. All requirements relative to concrete structures that are pertinent shall apply equally to work covered by this section.

1. Foundations shall be excavated to the depth shown on the plans, unless the character of the material encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer. Should suitable material not be encountered at depths to which it is practicable to excavate, piles shall be driven or other special treatment employed as the Engineer may direct. Piles shall be driven in conformity with the requirements of the plans and shall be either vertical or battered, as the Engineer may require. Special treatment of foundations shall conform to the requirements of the plans; or if not specified therein, shall be as directed by the Engineer and may be classed as extra work or additional work. No construction material shall be placed in any foundation until the Engineer has examined the material encountered and approved its character and the depth of the excavation.

2. Endwalls shall be built in the location and to the dimensions and details shown on the plans; or as ordered, and they shall be neatly and accurately finished, true to the lines and grades given. Pipes shall be of sufficient length to extend to the exposed face of the endwall, and the end shall be finished to provide neat, watertight joints. The ends of pipe culverts which enter endwalls on a skew shall be cut to the angle of the skew; or the short side of the pipe may be built out with adequate forms, if this method is approved by the Engineer.

3. Retaining Walls shall be built in the location and to the dimensions and details shown on the plans or as ordered. Drainage of retained material shall be provided as specified in Section 300000-2.16 and as shown on the plans.

4. Steps shall be built where indicated or directed to the dimensions and details shown on the plans or as ordered and in accordance with the requirements of these specifications.

SECTION 5.07 CATCH BASINS, MANHOLES AND DROP INLETS

5.07.01—Description:

Under this heading shall be included the construction of all catch basins, junction boxes, manholes and drop inlets (and also the alteration, reconstruction or conversion of such existing structures) all in conformity with the lines, grades, dimensions and details shown on the plans, or as ordered, and in accordance with the provisions of these specifications for the various materials and work which constitute the completed structure.

When it becomes necessary to increase the horizontal dimensions of manholes, catch basins, junction boxes and drop inlets to sizes greater than those shown on the plans in order to provide for multiple pipe installations or large pipes or for other reasons, the Contractor shall construct such manholes, catch basins and drop inlets to modified dimensions as directed by the Engineer.

5.07.02—Materials:

The materials to be used in the construction shall be those indicated on the plans or ordered by the Engineer and shall conform to Article M.08.02. Protective compound material shall conform to Subarticle M.03.01-11. Galvanizing shall conform to Article M.06.03.

Mortar shall conform to Article M.11.04.

Pervious material shall conform to Article M.02.05.

Geotextile shall be of a type appearing on the Department's Approved Products List for Geotextiles, referred to in Subarticle M.08.01-19 Geotextiles.

5.07.03—Construction Methods:

These structures shall be constructed in accordance with the requirements contained herein for the character of work involved. The provisions of Article 300000-6.02.03 pertaining to bar reinforcement shall apply except that shop drawings need not be submitted for approval, unless called for on the plans or directed by the Engineer. Welding shall be performed in accordance with the applicable sections of the AWS Structural Welding Code, D1.1.

The surfaces of the tops of all catch basins, junction boxes and drop inlets shall be given a coat of protective compound material immediately upon completion of the concrete curing period at the rate of .04 gallons per square yard (0.2 liter per square meter).

All masonry units shall be laid in full mortar beds.

Metal fittings for catch basins, junction boxes, manholes or drop inlets shall be set in full mortar beds or otherwise secured as shown on the plans.

Inlet and outlet pipes shall extend through the walls for a sufficient distance beyond the outside surface to allow for satisfactory connections, and the concrete or masonry shall be constructed around them neatly to prevent leakage along their outer surfaces. The pipe shall be cut flush with the inside face of the wall, or as shown on the plans.

When constructing a new drainage structure within a run of existing pipe, the section of existing pipe disturbed by the construction shall be replaced with new pipe of identical type and size extending from the drainage structure to the nearest joint of the existing pipe.

Pervious material shall be used for backfilling the upper portion of the excavation made for catch basins and drop inlets down to the elevation of the invert of the outlet pipe but in no case to a depth greater than 3 feet (1 meter) below the top of the structure. Drainage openings shall be formed in the four walls of the structure at or immediately above the bottom of the pervious backfill to convey subsurface drainage. The openings shall be covered with geotextile. Depending on the masonry used in the walls, such openings shall be formed by the insertion of 2-inch (50-millimeter) pipes, omission of a header brick or by leaving two open vertical joints in the masonry.

Frames, covers and tops which are to be reset shall be removed from their present beds, the walls or sides shall be rebuilt to conform to the requirements of the new construction and the tops, frames and covers reset, or the grates or covers may be raised by extensions of suitable height approved by the Engineer.

Extensions shall not be used on catch basins or drop inlets at pavement low points or where adjacent curbing is being raised. Extensions for catch basins or drop inlets shall be tack welded to the frame in four locations approximately at the mid points of each side of the frame. If the frames, covers or tops are broken or so damaged as to be unfit for further use, they shall be replaced with new, sound material conforming to the above requirements for the material involved.

SECTION 6.01 CONCRETE FOR STRUCTURES

6.01.01—Description:

Work shall include concrete for use in bridges and culverts, walls, retaining walls, catch basins, drop inlets and other miscellaneous construction as required. See division 03 for all concrete pertaining to the building structure. The concrete shall be composed of Portland cement, fine and coarse aggregate, admixtures if ordered, and water, prepared and constructed in accordance with these specifications, at the locations and of the form dimensions and class shown on the plans, or as directed by the Engineer.

The concrete shall be of three classes, Class "A," "C" and "F". The class to be used shall be as shown on the plans or designated herein, or as directed.

The use of truck-mixed or transit-mixed concrete is permitted for all Class "A," "C" and "F" concrete.

6.01.02—Materials:

The materials for this work shall conform to the requirements of Article M.03.01.

Material for stay-in-place metal forms shall be made of zinc-coated (galvanized) steel sheet conforming to ASTM Specification A653, Structural Steel (SS) Grade 33 through 80 (ASTM Specification A653M, Structural Steel (SS) Grade 250 through 550). The minimum gauge thickness shall be 20 gauge. Coating weight shall conform to ASTM A924, Class G235 (ASTM A924M, Class Z700) and shall otherwise meet all requirements relevant to steel stay-in-place metal forms and the placing of concrete as specified herein and as noted on the contract drawings.

Material for the form supports shall be fabricated from the same material and conform to the same material requirements as the forms themselves or they shall be fabricated from structural steel conforming to the requirements of ASTM A36 (ASTM A36M) which shall be hot-dip galvanized in accordance with ASTM A123 (ASTM A123M).

Lightweight filler material shall be as recommended by the form’s manufacturer.

6.01.03—Construction Methods:

1(a) Equipment: All equipment and tools used in the handling of materials, trucks used for transporting the batched material, the batching equipment, and concrete mixers used for the mixing of concrete shall comply with the requirements of Article 300000-4.01.03. When permitted by the Engineer, mixers of the batch type design with a minimum rated capacity of a 2-bag batch, may be used.

(b) Truck Mixed and Transit Mixed Concrete:

Definitions: Truck mixed concrete shall be construed to mean concrete mixed completely in a truck mixer after its arrival at the point of placement. Transit mixed concrete shall be construed to mean concrete mixed completely in a truck mixer while en route to the point of placement.

General Requirements: The location and capacity of the batch plant and complement of truck mixers for truck or transit mixed concrete shall be adequate for continuous placement of concrete in the forms. If in the opinion of the Engineer, undue delay in deliveries do occur, and concrete already in place takes initial set, all such material in place may be rejected.

The batch plant, truck mixers and related equipment will be inspected by the Engineer; and these, as well as all methods of operation related thereto, shall be approved before the concrete is batched.

The concrete shall be discharged within one and one-half hours from the time the dry aggregates are loaded into the truck mixer; otherwise the concrete shall be disposed of by the Contractor at his expense.

With each delivery of concrete, the Contractor shall furnish a ticket indicating the proportionment of the batch and stamped by an approved time clock indicating the time the batch is placed in the truck mixer.

This ticket shall be presented to the Engineer or his authorized representative before discharge of the concrete will be permitted.

After each time the drum of any mobile mixer is washed, the Contractor shall, at his own expense, add one-half cubic foot (0.02 cubic meter) mixture of sand and cement for each cubic yard (cubic meter) of concrete being placed in the drum of the mixer. The same proportions as specified for the concrete shall be used, and the mixture shall be introduced immediately before or at the time of batching.

Truck Mixers: The capacity of truck mixers shall be in accordance with the manufacturer's ratings, except that the maximum permissible capacities, expressed as percentages of the total volume of the drum or container, shall not exceed 63.25%.

Each truck mixer shall have an attached metal standard rating plate on which are stated the capacities, in terms of volume, of mixed concrete, for the various uses applicable to the equipment. When the manufacturer's ratings of capacity are less than the limit indicated above, the manufacturer's ratings shall govern.

Further, truck mixers shall be equipped with a suitable means by which the number of revolutions of the drum or blades may be readily verified.

Truck mixers shall be of standard type, size and manufacture and shall be either of the horizontal axis revolving-drum type, the inclined axis revolving-drum type, or the open-top revolving blade or paddle type.

Truck mixers must be inspected and approved by the Engineer.

Loading, Water and Transportation: The mix shall be in the proportions required for the work and placed in the drum of the mixer. Water shall be added to the mix, and the mixing conditions shall be in accordance with one of the following methods:

Truck-Mixed Concrete: Water shall be introduced into the mixing drum only after arrival at a level area on the site where the concrete is to be placed and under the supervision of the Engineer. The water shall be measured accurately by volume or mass by an approved adjustable measuring device which shall measure the required quantity under all operating conditions within a tolerance of 1 quart (1 liter) or 1%, whichever is greater. The device shall be such that the flow of water shall be stopped automatically when the required quantity has been delivered. The mixer shall be equipped with an approved device which shall record the number of revolutions of the drum or blades during mixing. The mixing procedures shall be carried out at the site as hereinafter specified.

Transit-Mixed Concrete: Water shall be introduced into the mixing drum while the mixer is at the batch plant. The water shall be measured and controlled as specified above. The mixing procedure shall be carried out during transportation as hereinafter specified. Each truck mixer shall be equipped with a readily visible device that will record accurately the number of revolutions of the drum or blades at mixing speed

from the moment of batching. This equipment shall be set into operation only at the batch plant by the inspector and shall be so constructed as to show evidence of any tampering or misoperation.

Any one of the following shall be sufficient cause for the rejection of any load of truck-mixed or transitmixed concrete: when the elapsed time exceeds that which is permitted, when the mixing revolutions exceed 100, when the recording device has been tampered with or misoperated after the batching, when, at the time of placing, the air content or slump are not within specified ranges, when there is evidence of segregation or when initial set has taken place.

Mixing Procedure and Delivery: When the truck mixer is loaded in excess of 50% of the gross volume of the drum or container, the mixing period shall consist of not less than 60 revolutions of the drum or blades at mixing speed, after the water is added; if loaded to not more than 50%, the mixing period shall consist of not less than 40 revolutions of the drum or blades at mixing speed.

For the revolving drum type mixers the mixing speed shall be not less than 4 revolutions per minute of the drum nor greater than a speed which will produce a peripheral velocity of the drum of 225 feet per minute (1.14 meters per second). For the revolving blade type mixers the mixing speed shall be not less than 4, nor more than 16, revolutions per minute of the mixing blades.

Agitating speed for both the revolving drum and revolving blade type of mixers shall be not less than 2, nor more than 6, revolutions per minute of the drum or the blades.

In no case shall mixing exceed 100 revolutions at mixing speed. Mixing beyond 100 revolutions shall be done at agitating speed.

In discharging truck mixers, the direction of rotation of drum or blades shall be manipulated so as to avoid segregation.

Slump: When the slump does not meet the specification requirements, modification of the concrete mix may be permitted if, in the opinion of the Engineer, no harmful effect upon the structural qualities or appearance of the concrete will result. If permitted by the Engineer, modifications shall be limited to the addition of not more than 50 pounds (30 kilograms) of Portland cement per cubic yard (cubic meter) of concrete to decrease the slump or to the addition of water to increase the slump. The amount of water or cement added shall be further limited to the minimum needed to meet slump requirements. The cost of additional material and the work connected with each modification shall be borne by the Contractor. The addition of cement or water, or both, for the purpose of re-tempering concrete will not be permitted.

(c) Vibrators: Not less than two vibrating units, including source of power, shall be available on the work and shall be of the mechanical immersion type, in good operating condition at each pouring of concrete in order to insure satisfactory and uninterrupted vibration during placing. They shall be capable of transmitting vibrations to the concrete at frequencies of not less than 4,500 impulses per minute. Vibrators shall be used only when directed by the Engineer.

(d) Trucking Equipment: Trucks used for the transporting of the batched material from the batcher plant to the mixer shall conform to the requirements of Subarticle 300000-4.01.03-E.

2. Falsework and Centering: All falsework and centering required shall be adequate for the type of construction involved. Details of this construction shall be proposed by the Contractor and unless otherwise authorized shall be submitted to the Engineer for his information before construction is started. Approval of the plans or methods proposed for such construction shall not serve to relieve the Contractor of any of his responsibility for the successful completion of the project.

Suitable provision shall be made to secure the permanent camber required in the superstructure, and means of adjustment shall be provided so as to correct any possible settlement or deflection during construction. The method of adjustment shall be such as to permit the gradual lowering of the falsework or centering when these are to be removed. Falsework and centering shall remain in place for a period as

stated in Subarticle 300000-6.01.03-20. No falsework or centering shall be removed without the permission of the Engineer.

3. Forms: Forms shall be built true to lines and grades designated, shall be strong, stable, firm, mortartight and adequately braced or tied, or both. They shall be designed and constructed to withstand all loads and pressures including those imposed by plastic concrete, taking full account of the stresses due to the rate of pour, effect of vibration and conditions brought about by construction methods. Where necessary, forms shall be constructed to compensate for variations in camber of supporting members and allow for deflections.

Internal voids may be formed by the use of heavy paper or fiber forms especially made for this purpose, or with an alternate acceptable to the Engineer. These forms must be of substantial construction and adequately waterproofed in order to maintain their shape during the entire construction cycle. The end caps shall also be of similar construction. These forms shall be held in place against uplift or lateral displacement during the pouring and vibrating of the concrete by substantial wire ties or other satisfactory means. Before incorporating the forms in the work, a sample 4 feet (1 meter) in length with end caps shall be furnished the Engineer for approval. These forms shall not be incorporated in the work until the Engineer has approved the sample submitted.

If requested, form work plans shall be submitted to the Engineer by the Contractor before form work is started. The furnishing of such plans, however, shall not serve to relieve the Contractor of any of his responsibility for the successful completion of the work.

Forms shall be filleted at all sharp corners, unless otherwise ordered or permitted, and shall be given a slight bevel or draft in the case of projections to insure satisfactory removal.

Materials for forms and their supports, ties and bracing, shall be of the type, quality and strength to achieve the foregoing requirements without impairment to the structural qualities or appearance of the concrete structure. Form material in contact with concrete shall be of a quality to provide the hereinafter required concrete surface smoothness; and, unless otherwise authorized, the contact surface shall be oiled with a light, clear paraffin base oil which will not damage, discolor or adhere to the concrete; or, as an alternate, the form may be lined with an approved composition form lining.

Materials and workmanship for forms for concrete to remain exposed in the finished work shall be such as to provide a smooth concrete surface of good appearance and texture, free of voids, indentations, protrusions or bulges and within tolerances consistent with good trade practices. If panels are used, they shall be evenly placed in columns or rows if their positioning is to be visible after the concrete is finished.

These same requirements shall apply to forms for concrete not to remain exposed in the finished work except that minor irregularities where form boards or panels join and variations in form pattern will be acceptable.

Metal ties and anchors to hold the forms in alignment and location shall be so constructed that the metal work can be removed to a depth of at least 2 inches (50 millimeters) from the concrete surface without damage to the concrete. All cavities resulting from the removal of metal ties shall be filled with cement mortar of the same proportions used in the body of the work and the surface finished smooth and even,

and if exposed in the finished work, shall conform to the texture and color of adjacent surfaces. With permission of the Engineer, the Contractor need not remove from the underneath side of bridge decks portions of metal devices used to support reinforcing steel providing such devices are of material, or are adequately coated with material, that will not rust or corrode.

Date of Completion: The year in which each structure is completed shall be shown in at least two places on each concrete superstructure unless otherwise ordered by the Engineer. Usually the date shall be placed in diagonally opposite ends of the bridge parapets adjacent to traffic. The numerals will be furnished by the Contractor. They shall be carefully set by the Contractor; and their subsequent removal after the concrete is placed and the finishing shall be carefully done so that the impression of the numerals in the concrete is clear and sharp, with no broken edges or other imperfections.

Ornament or Reverse Moulds: Ornamental work, when so noted on the plans, shall be formed by the use of reverse moulds. These moulds shall be produced by a qualified manufacturer approved by the Engineer. They shall be carefully built by the most approved modern methods and in accordance with the general dimensions shown on the plans. Additional details necessary to construct the moulds shall be worked out by the manufacturer and shall be such as to produce ornaments having the appearance indicated on the plans. The manufacturer shall prepare all detailed drawings that he may require for his guidance, and all such drawings as well as all models or carvings that he may prepare shall be approved by the Engineer before the moulds are made.

Moulds shall be carefully handled, shipped and stored so as to prevent all damage to the ornaments. They shall be delivered at the site of the work completely assembled and of the required size and shape in order to facilitate their proper placing. The Contractor shall be responsible for their condition at all times, and he will be required to remove and replace any damaged or defective moulds at his own expense.

The moulds shall be fitted into the surrounding form work so that they will act as a substitute for the ordinary forms which would be required in the area.

The surfaces of the moulds shall be given a coating of grease or lubricant to prevent the adherence of concrete. Any material which will adhere to or discolor the concrete shall not be used.

Utility Installations: On any structure where it becomes necessary to install any public utility, i.e., telephone, electric light or power conduits; gas, water or sewer pipes; pneumatic, oil or any other lines, the utilities concerned will furnish, delivered at the site, all material necessary for such installation.

Unless specifically otherwise ordered, the Contractor shall erect or install such equipment or material as shown on the plans; or if not shown thereon, he shall comply with the Engineer's instructions.

Whether or not the presence of any public utilities is mentioned on the plans, the Contractor shall, by any means at his disposal, apprise himself of the location of any and all of them. He shall use every effort to protect them from damage of any nature whatsoever, which might result from carelessness or negligence in any of his operations. He shall be held solely and strictly responsible for any damage resulting from such negligence or carelessness.

In cases where any utilities are to be installed on, under or within the construction limits of any structure—and the Contractor does not participate actively in the work—he shall arrange his operations as to cause no inconveniences or interruption to the progress of such installation. The Contractor shall extend his fullest cooperation to the construction forces of any utility company which may be operating within the limits of the contract.

Stay-in-Place Metal Form System: Stay-in-place metal forms shall have a minimum depth of form valley equal to two inches (50 millimeters). The forms shall have closed tapered ends. Lightweight filler material shall be used in the form valleys.

The metal forms shall be designed on the basis of dead load of the form, reinforcement and the plastic concrete, including the additional weight of concrete due to the deflection of the metal forms, plus 50 pounds per square foot (2.40 kilopascals) for construction loads. The allowable stress in the corrugated form and the accessories shall not be greater than 0.725 times the yield strength of the furnished material and the allowable stress shall not exceed 36,000 psi (250 megapascal). The span for design and deflection shall be the clear distance between edges of the beams or girders less two inches (50 millimeters) and shall be measured parallel to the form flutes. Maximum deflection of the forms under the weight of the plastic concrete, reinforcement, and forms shall not exceed 1/180 of the form span or 0.5 inches (13 millimeters), whichever is less. The permissible form camber shall be based on the actual dead load condition. Camber shall not be used to compensate for deflection in excess of the foregoing limits.

Form support angles shall be designed as a cantilever. The horizontal leg of the form's support angle shall not be greater than 3 inches (75 millimeters).

Before fabricating any material, the Contractor shall submit working drawings to the Engineer for review in accordance with Article 1.05.02-2, Working Drawings. These drawings shall include the proposed method of form construction, erection plans including weld procedure(s), material lists, material designation, gage of all materials, and the details of corrugation. Also, copies of the form design computations shall be submitted with the working drawings.

Form supports shall be used and no stay-in-place metal forms shall be placed over or be directly supported by the top flanges of beams or girders. The form supports may be supported by or be attached to the top flanges. Stay-in-place metal forms shall not be used in bays where longitudinal slab construction joints are located. Stay-in-place metal forms shall not be used under cantilevered slabs such as the overhang outside of fascia members.

Welding to the top flanges of steel beams and girders is not allowed in the areas where the top flanges are in tension, or as indicated on the plans. Alternate installation procedures shall be submitted addressing this condition.

Drilling of holes in prestressed concrete beams or the use of power-actuated tools on the prestressed concrete beams for fastening of the form supports to the prestressed concrete beams will not be permitted. No welding will be permitted on the reinforcing steel in the prestressed units.

All edges of openings cut for drains, pipes, and similar appurtenances shall be independently supported around the entire periphery of the opening.

All fabricated stay-in-place metal forms shall be unloaded, stored, and handled in such a manner as to preclude damage to the forms. Damaged material shall be replaced at no additional cost. Any exposed form or form support metal where the galvanized coating has been damaged, shall be thoroughly cleaned, wire brushed, then coated with two coats of a zinc dust-zinc oxide primer, FS No. TT-P-641d, Type II, as directed by the Engineer.

All fabricated stay-in-place metal forms shall be stored at the project site at least four inches (100 millimeters) above the ground on platforms, skids or other suitable supports and shall be protected against corrosion and damage.

Forms shall be installed from the topside in accordance with the manufacturer's placing plans, recommended details, and printed instructions. Forms shall be constructed to the lines, grades, shapes, and dimensions shown on the plans, unless otherwise directed by the Engineer. Form supports shall ensure that forms retain their correct dimensions and positions during use at all times. Form supports shall provide vertical adjustment to maintain design slab thickness at the crest of corrugation, to compensate for variations in camber of beams and girders, and to allow for deflections.

Field cutting of form sheet metal shall be made by a steel cutting saw. Supports, closures and cut-outs shall be cut with shears or saw. No flame cutting will be permitted.

All welding shall be accomplished by Connecticut certified welders in accordance with Subarticle 300000-6.03.03 – 6, Welding.

The steel form supports shall be placed in direct contact with the flange of stringer or floor beam flanges and attached by bolts, clips, welding where permitted, or other approved means. Form sheets shall not be permitted to rest directly on the top of the stringer or floor beam flanges. Forms shall be securely fastened to form supports with self-drilling fasteners and shall have a minimum bearing length of one inch (25 millimeters) at each end.

In the areas where the form sheets lap, the form sheets shall be securely fastened to one another by fasteners at a maximum spacing of eighteen inches (450 millimeters). The ends of the form sheets shall be securely attached to the support angles with fasteners at a maximum spacing of eighteen inches (450 millimeters) or two corrugation widths, whichever is less. Welding of forms to supports is not allowed. The depth of the concrete slab shall be as shown on the plans and the corrugated forms shall be placed so that the top of the corrugation will coincide with the bottom of the deck slab. No part of the forms or their supports shall protrude into the slab. All reinforcement in the bottom reinforcement mat shall have a minimum concrete cover of one inch (25 millimeters) unless noted otherwise on the plans.

The completed stay-in-place metal form system shall be sufficiently tight to prevent leakage of mortar or concrete.

Where forms or their installation are unsatisfactory in the opinion of the Engineer, either before or during placement of the concrete, the Contractor shall correct the defects before proceeding with the construction work. The cost of such corrective work shall be at the sole expense of the Contractor.

4. Handling Material: The requirements of Subarticle 300000-4.01.03-B shall apply.

5. Composition: The requirements of Subarticle 300000-4.01.03-A shall apply except for the proportionment of the concrete mix which shall be in accordance with Article M.03.01, and the air content for Class "C" or Class "F," as the case may be, used for bridge decks, including curbs, sidewalks and railings attached there on or attached thereto. This concrete shall contain not less than 5% nor more than 7% entrained air at the time the concrete is deposited in the forms. For pumped concrete, the percentage of entrained air shall be determined at the placement end of the pump line.

Unless otherwise directed by the Engineer, all concrete for bridge decks shall contain a retarder admixture which the contractor shall add to the concrete mix in predetermined amounts varying with the temperature and other working conditions.

On any one structure, the admixture for a specific purpose shall be the particular product of one manufacturer only. When admixtures for different purposes are used together, the Contractor shall submit proof of their compatibility prior to use.

6. Consistency: The consistency shall be determined by the AASHTO Method T 119. A uniform consistency shall be continuously maintained. When Class "A" and Class "C" concrete is not to be vibrated, the allowable range of slump shall ordinarily be not less than 2 nor more than 4 inches (50 millimeters nor more than 100 millimeters). When Class "A" and Class "C" concrete is to be consolidated by vibration, the slump shall be not more than 2 1/2 inches (60 millimeters); and for Class "F" concrete, the slump shall be not more than 3 inches (75 millimeters). Slumps outside these limits shall be used when, in the opinion of the Engineer, conditions are such that satisfactory workability cannot be obtained within such limits. Concrete mixes designed by the Contractor so as to be pumpable, shall not be subject to the above conditions. The desired slump shall be indicated on the mix design submitted for approval. The slump shall be determined at the placement end of the pump line.

7. Mixing Concrete: Mixing shall be in an approved mixer capable of combining the aggregates, cement, and water into a thoroughly mixed and uniform mass within the specified mixing period and of discharging the mixture without segregation. Each mixer shall have attached in a prominent place a manufacturer's plate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

The mixing time requirements shall be in accordance with the recommendations of the manufacturer of the mixer. If a mixing time of less than 60 seconds is recommended, the Contractor shall furnish test data acceptable to the Engineer, verifying that the reduced mixing time will produce uniform concrete conforming to the provisions of AASHTO M157.

The mixer shall be operated at a drum speed as shown on the manufacturer's name plate on the approved mixer. Any concrete mixed less than the specified time shall be discarded and disposed of by the Contractor at his expense. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity in cubic feet (cubic meters), as shown on the manufacturer's standard rating plate on the mixer, except that an overload up to 10% above the mixer's nominal capacity may be permitted provided concrete test data for strength and uniform consistency are satisfactory, and provided no spillage of concrete takes place.

Failure of the water measuring device or of the timing device shall result in suspension of mixing until correction has been made, except that, with prior approval of the Engineer, operations may be allowed to continue for the balance of the day if secondary controls can be demonstrated.

Truck mixed or transit mixed concrete may be used with the written permission of the Engineer for limited amounts or other exceptional cases. If its use is so allowed, the provision of Section 300000-6.01 relating to truck mixers and truck mixed and transit mixed concrete shall fully apply.

The first batch of concrete materials placed in the mixer shall contain an additional quantity of sand, cement, and water sufficient to coat the inside surface of the drum without diminishing the mortar content of the mix. Upon the cessation of mixing for any considerable length of time, the mixer shall be thoroughly cleaned.

Hand mixing shall not be permitted except in cases of emergency and with the permission of the Engineer. When permitted, it shall be done only on watertight platforms. The sand shall be spread evenly over the platform, and the cement spread upon it. The sand and cement shall then be thoroughly mixed while dry by means of shovels until the mixture is of a uniform color, after which it shall be formed into a "crater" and water added in an amount necessary to produce mortar of the proper consistency. The material upon the outer portion of the "crater" ring shall then be shoveled to the center and the entire mass turned and sliced until a uniform consistency is produced. The coarse aggregate shall then be thoroughly wetted and added to the mortar and the entire mass turned and returned at least 6 times and until all of the

stone particles are thoroughly covered with mortar and the mixture is of a uniform color and appearance. Hand mixed batches shall not exceed 1/2 cubic yard (0.5 cubic meter) in volume. Hand mixing will not be permitted for concrete to be placed under water.

8. Placing Concrete: Concrete, except for central plant-mix, truck or transit-mixed, shall be placed in the forms immediately after mixing; and in no case shall concrete be used which does not reach its final position in the forms within 60 minutes after the time that water is first added to the mix, except that the Engineer reserves the right to alter this time by as much as one-half when necessary to achieve the requirements related to set and plasticity.

The temperature of the concrete at the time of placement shall not be less than 60 F (15.5 C) or greater than 90 F (32 C). For pumped concrete, the temperature shall be determined at the placement end of the pump line. The temperature of the concrete shall be determined in accordance with ASTM C1064.

The use of long chutes and troughs for conveying concrete from the mixing plant to the forms will be permitted only on authority from the Engineer. If such conveyors are allowed and the quality of concrete as it reaches the forms or the method of placing or working it therein are not satisfactory, the Engineer may order their use discontinued and the substitution of a satisfactory method of placing. Where steep slopes are required, chutes and troughs shall be equipped with baffle boards or be in short lengths that reverse the direction of movement. All chutes, troughs and pipes shall be kept clean and free from coatings of hardened concrete. Open troughs and chutes shall be either of metal or metal lined and shall extend as nearly as possible to the point of deposit. When the discharge must be intermittent, a hopper or other device for regulating the discharge shall be provided.

During placing operations, the concrete shall not come in contact with any aluminum.

Unless permission is obtained from the Engineer, concrete shall not be dropped a distance of more than 5 feet (1.5 meters); and special care shall be taken to fill each part of the forms by depositing the concrete as near final position as possible. The coarse aggregate shall be worked back from the forms and the concrete forced around the reinforcement without displacing the bars. After initial set of the concrete, the forms shall not be jarred; and no strain shall be placed on the ends of projecting reinforcement.

Concrete shall be placed in horizontal layers. When less than a complete layer is placed in one operation, it shall be terminated in a vertical bulkhead. Each layer shall be placed and compacted before the preceding layer has taken initial set, to prevent injury to the green concrete and to avoid surfaces of separation between the layers.

Concrete shall be compacted by continuous working with suitable tools or by vibrating as ordered by Engineer. The number and type of vibrators required, the length of the vibrating period and the location of the vibrators shall be as required by the Engineer.

Special care shall be taken in placing and compacting concrete around ornamental moulds, and vibrating equipment shall be used with caution. The vibrator shall not touch the moulds at any time. A gentle vibration shall be used, sufficient to assure the proper flow of the materials and to bring the mortar into complete contact so that all contours of the ornaments will be sharp. Tarpaulins or heavy paper shall be hung over the moulds, the bottom of which shall be kept constantly immersed in the fresh concrete, in order to prevent splashing the surfaces of the moulds.

When the placing of concrete is temporarily discontinued, the necessary keys or joints shall be formed as shown on the plans or as ordered, and the concrete after becoming firm enough to retain its form, shall be cleaned of laitance and other objectionable material to a sufficient depth to expose sound concrete.

Joints shall be formed only in the locations shown on the plans or as permitted by the Engineer.

Featheredges at construction joints will not be permitted.

Immediately following the discontinuance of the placing of concrete, all accumulations of mortar splashed upon reinforcing steel and the surface of the forms shall be removed. Dried mortar chips and dust shall not be puddled into the unset concrete. If accumulations are not removed prior to the concrete becoming set, care shall be taken not to injure or break the concrete-steel bond, at and near the surface of the concrete, while cleaning the reinforcing steel.

9. Depositing Underwater Concrete: Concrete shall not be exposed to the action of water before setting, or deposited in water, except with the approval of the Engineer and under his immediate supervision. When concrete is so deposited, the method and manner of placing shall be as hereinafter designated.

The Contractor shall design and submit to the Engineer a concrete mix that he proposes to use. The mix shall be designed in accordance with the applicable sections of ACI 211 and ACI 318.

During placing operations, the concrete shall not come in contact with any aluminum.

Concrete deposited under water shall be carefully placed in a compacted mass in its final position by means of a tremie, a bottom dump bucket or other approved method and shall not be disturbed after being deposited. Special care must be exercised to maintain still water at the point of deposit. No concrete shall be placed in running water, and all form work designed to retain concrete under water shall be watertight.

The consistency of the concrete shall be carefully regulated, and special care shall be exercised to prevent segregation of the materials. The method of depositing concrete shall be so regulated as to produce approximately horizontal surfaces. Concrete deposited under water shall be placed continuously from start to finish whenever possible, and each succeeding layer shall be placed before the preceding layer has taken initial set.

When a tremie is used, it shall consist of a suitable hopper and a tube having a diameter of not less than 10 inches (254 millimeters). If the tube is constructed in sections, it shall have watertight couplings. The means of supporting the tremie shall be such as to permit the free movement of the discharge end over the area of the work and shall be such as to permit it to be rapidly lowered when necessary to choke off or retard the flow. The discharge end shall be plugged at the start of the work to prevent water from entering the tube. It shall be entirely sealed at all times, and the tremie tube kept full of concrete to the bottom of the hopper. When a batch is dumped into the hopper, the tremie shall be slightly raised, but not out of the concrete at the bottom, until the batch discharges to the bottom of the hopper. The flow shall then be stopped by lowering the tremie. The flow shall be continuous until the work is complete.

When concrete is placed by means of a bottom dump bucket, the bucket shall have a capacity of not less than one cubic yard (0.8 cubic meters). The bucket shall be lowered gradually and carefully until it rests upon the concrete already placed. It shall then be raised very slowly as the concrete is discharged, the intent being to maintain, as nearly as possible, still water at the point of discharge and to avoid agitating the mixture.

Before placing substructure concrete, all laitance or other unsound material shall be removed from the surface of the underwater concrete.

10. Concreting in Cold Weather: During the period from October 15 to April 15 of the subsequent year, cold-weather concreting procedures shall be employed by the Contractor, unless otherwise directed by the

Engineer. Cold-weather concreting practices shall include taking measures to ensure that the temperature surrounding the structure is kept above 60°F (16°C) for a period of 5 days after placing the concrete, and above 40°F (5°C) for an additional nine days. The temperature shall then be gradually lowered to that of the surrounding atmosphere. Concrete test specimens prepared during the period noted shall be cured in the same manner as the structure that they represent, in accordance with ASTM C 31 (AASHTO T 23). If tests performed on the specimens indicate that sufficient strength has been achieved, the Engineer may reduce the amount of time that the structure must be protected and heated.

Sufficient heating apparatus of the kind approved by the Engineer, such as stoves, salamanders, or preferably steam equipment, and fuel to furnish all required heat, shall be supplied. All water used for mixing concrete shall be heated, but shall not exceed a temperature of 150°F (65°C).

The temperature of the mixed concrete shall not be less than 60°F (16°C) at the time of placing in the forms.

If aggregates are heated either by steam or by dry heat, the temperature of the aggregate shall be not less than 50°F (10°C), nor more than 100°F (37°C). The heating apparatus shall be such as to heat the mass uniformly and preclude the possibility of the occurrence of hot spots which will burn the material.

In case of extreme weather conditions, the Engineer may at his discretion vary the temperature limitations for water, aggregate and mixed concrete.

Except for deck slabs and thin wall sections, form insulation may be substituted for a heated enclosure, provided it can be demonstrated to the satisfaction of the Engineer that the insulation material proposed for use will keep the concrete within the above specified temperature limits for the specified periods of time. When the use of form insulation is permitted, sufficient provision shall be made by the Contractor so that the surface and interior temperature of the concrete may be determined. If the thermometric readings indicate that the required temperature is not being maintained, the structure shall be promptly enclosed and heat furnished as provided hereinabove.

When form insulation is substituted for a heated enclosure, forms shall not be stripped until permission is granted by the Engineer.

11. Anchorages: Anchor bolts and similar materials which are to be placed either at the time the substructure is built, or during the erection of the superstructure, shall be carefully and accurately set to the requirements of the plans or as ordered at such time as the Engineer may approve or direct.

(a) Setting Anchorages at time of Placing Substructure Concrete: When noted on the plans or ordered by the Engineer, the anchor bolts and similar materials shall be accurately set prior to placing concrete for the bridge seat.

(b) Setting Anchorages in Formed Holes: When indicated on the plans, the anchor bolts and similar materials shall be accurately set in formed holes in accordance with details and dimensions shown. The space around the anchorage material shall be completely filled with non-shrink, non-staining grout conforming to the requirements of Subarticle M.03.01-12.

(c) Setting Anchorages in Drilled Holes: When the Contractor is not required to set anchorages at the time of constructing the substructure, he may set the anchorages as in (a) and (b) above, or he may drill holes having a diameter of 4 inches (100 millimeters) and a depth suitable to receive the bolts in the correct locations perpendicular to the plane of the bridge seat. Anchor bolts shall be grouted into clean drilled holes in accordance with the requirements of "Setting Anchorages in Formed Holes." When anchorage

material is to be furnished by the Contractor for the superstructure and placed by the Contractor of the substructure, the necessary material shall be fabricated and delivered to the site of the work at such times as it may be required for proper inclusion in the substructure construction.

In locating anchor bolts in relation to slotted holes in expansion shoes, due consideration shall be given to the temperature at the time of erection.

Anchor bolt holes shall be clean and free of dirt, moisture or other foreign materials at the time of setting anchor bolts. Precaution shall be taken to prevent damage to concrete due to freezing of water in anchor bolt holes.

12. Construction Joints: Construction joints other than those shown on the plans will not be permitted without prior approval of the Engineer. When the placing of concrete is to be interrupted and a construction joint formed, provision shall be made for interlocking with the succeeding layer by roughening the surface and providing keyways, dowels or similar construction shown on the plans or as ordered.

In joining fresh concrete to concrete that has already set, the work already in place shall have its surface cut over thoroughly with a suitable tool to remove all loose and foreign material. This surface shall then be washed and scrubbed with wire brooms and thoroughly drenched with water until saturated. It shall remain saturated until the new concrete is placed. Immediately prior to the placing of the new concrete, all forms shall be drawn tight against the concrete already in place.

In construction joints exposed to view or in other construction joints where seepage of water is particularly objectionable, a baffle strip of copper, zinc, sheet lead or other approved materials shall be inserted. This strip shall be placed not less than 3 inches (75 millimeters) from the face of the concrete and shall extend into each section of the concrete a distance of not less than 2 inches (50 millimeters).

13. Expansion Joints: Expansion joints shall be built in the locations and to the dimensions and details shown on the plans.

Sliding surfaces of metal shall be planed true and smooth, the marks of the plane paralleling the movement of the joint. Expansion plates shall be well anchored as shown on the plans. All sliding surfaces of expansion plates shall be thoroughly coated with graphite or other approved lubricant just before being placed in position and special care taken to avoid placing concrete in such manner as to interfere with their free action.

Open joints shall be placed at locations designated on the plans and shall be formed by the insertion and subsequent removal of templates of wood, metal or other suitable material. The templates shall be so constructed that their removal may be readily accomplished without injury to the work.

Filled joints shall be made with a joint filler, the materials for which shall conform to the requirements of the plans and of these specifications.

Mortise joints shall be as shown on the plans and, in general, shall consist of a tenon of concrete or metal sliding in a suitable concrete or metal socket or mortise. The construction shall be such as to permit freedom of movement and such as to be, as far as possible, watertight and rust proof. Metal flashing shall be used as shown on the plans or when ordered by the Engineer.

Special types of expansion joints shall conform to the dimensions and details shown on the plans.

14. Curing Concrete: Concrete surfaces exposed to conditions causing premature drying shall be protected by covering, within 2 hours of placing. Concrete shall be cured as specified in Subarticle 300000-4.01.03-F.7 except Liquid Membrane-Forming Curing shall not be used. Other means of curing may be used provided that by either field or laboratory demonstration it can be shown that the material, or method used, sufficiently supplies necessary moisture to the concrete or causes the concrete to retain moisture, is not injurious to concrete and is not toxic.

Curing shall continue for a period of not less than 7 days after placing the concrete. Other precautions to insure the development of strength or to prevent injury shall be taken as the Engineer may direct.

15. Removal of Forms: The forms for any portion of the structure shall not be removed until the concrete is strong enough to avoid possible injury from such removal. Forms and their supports shall not be removed without the approval of the Engineer. Supports shall be removed in such a manner as to permit the concrete to take up the stresses due to its own mass uniformly and gradually.

If field operations are controlled by flexural-strength tests, the flexural strength of the concrete in the structure shall be monitored by the penetration-resistance tests, except in cases where the Engineer directs the use of third-point loading of test beams or splitting-tensile tests of cylinders. In this case, the Engineer shall be guided by the following considerations: penetration-resistance tests will be valid only for concretes containing coarse traprock aggregate with a top size to 1 1/2 inches (38 millimeters); beam tests will be valid for concrete containing all types and sizes of coarse aggregates; and, splitting-tensile tests will be valid for concrete containing any size of traprock aggregate.

If field operations are controlled by cylinder tests, the removal of forms, supports and housing and the discontinuance of heating and curing may be begun when the strengths reach the values which shall be fixed by the Engineer.

If field operations are not controlled by one of the above tests, the following period, exclusive of days when the temperature is below 40°F (5°C), may be used as a guide for the removal of forms:

Arch Centers	14 to 28 days
Centering Under Beams	14 to 28 days
Floor Slabs	7 to 14 days
Walls	24 hours to 4 days
Columns	2 to 7 days

To facilitate finishing, side forms carrying no load may be removed after 24 hours with the permission of the Engineer, but the curing process must be continued for seven days.

Ornament moulds shall be removed in the same manner as the usual form work. In case a portion of the plaster work remains in the concrete after the mold is removed, this material shall be carefully removed with a wood chisel, wood mallet or wire brush, using a chipping action wherever possible, and taking care that no damage is done to the concrete. No work of this nature shall be started until at least ten days after the forms have been removed.

16. Surface Finish: The external surface of all concrete shall be thoroughly worked during the operation of placing by means of tools of an approved type. The working shall be such as to force all coarse aggregate from the surface and thoroughly work the mortar against the forms to produce a smooth finish free from water and air pockets, segregated materials, or honeycomb. Unless otherwise authorized by the Engineer, the surface of the hardened concrete shall be finished immediately after the removal of the forms. All voids and honeycomb on the surface shall be filled and finished to conform to the surrounding con-

crete surface immediately after the forms are removed and before the finishing process is started. The finish shall be governed by the "Table of Finishes" shown elsewhere herein.

Float Finish: This finish shall be formed by placing an excess of material in the form and removing or striking off of such excess with a template, forcing the coarse aggregate below the mortar surface. There shall be created no concave surfaces in which water will be retained. After the concrete has been struck off as above described, the surface shall be thoroughly worked and floated with a wooden, canvas or cork float, the operation to be performed by skilled and experienced concrete finishers. Before this last finish has set, the surface shall be lightly stripped with a fine brush to remove the surface cement film, leaving a fine grained, smooth, but sanded texture. Curing, as specified elsewhere, shall follow.

Grout Clean-Down Finish: As soon as all cavities have been filled as required elsewhere and the cement mortar has set sufficiently, grout clean-down shall be performed as follows:

(1) All burrs, unevenness, laitance, including that in air holes, and any other material which will adversely affect the bond of the grout to the concrete, shall be removed by approved methods. This cleaning shall be done from the top or uppermost part of the surface to be finished to the bottom.

(2) A mixture of a fine aggregate and Portland cement shall be thoroughly blended while dry. The proportions shall be such that when mixed with the proper amount of water, the color will match that of the concrete to be finished. The proportions shall be determined by trial panels. Water shall be added to this mixture in an amount which will bring the grout to a workable thick paint-like consistency.

(3) The surface to be treated shall be thoroughly wetted with a sufficient amount of water to prevent the absorption of water from the grout. Grout shall then be applied to the wetted surface before setting of the grout occurs. Grout which has set, shall not be re-tempered and shall be disposed of by the Contractor at his expense.

The grout shall be uniformly applied by brushes, spray gun, or sponge rubber float over the entire surface, completely filling all air bubbles and holes. Immediately after applying the grout, the surface shall be floated with a cork, or other suitable float, scouring the surface vigorously. While the grout is still plastic, the surface shall be finished with a sponge rubber float, removing all excess grout but without removing grout from holes or depressions.

(4) The surface shall be allowed to dry thoroughly, and shall then be rubbed vigorously with burlap to remove completely any dried grout. No visible film of grout shall remain after this rubbing.

Operations (3) and (4) shall be completed in one and the same day for the area treated.

(5) Curing of the concrete so treated shall then be resumed as specified elsewhere or, if completed, for at least 1 more day.

Rubbed Finish: The entire surface shall be thoroughly wet with a brush and rubbed with a No. 16 carborundum stone or an abrasive of equal quality, bringing the surface to a paste. The rubbing shall be continued sufficiently to remove all form marks and projections, producing a smooth, dense surface without pits or irregularities. The paste formed by the rubbing as above described may be finished by carefully stripping with a clean brush, or it may be spread uniformly over the surface and allowed to reset. After the concrete has set for 7 days or such period as the Engineer may direct, the surface shall be rubbed again, with a carborundum stone, until a uniform even color is obtained. No mortar shall be used during this second rubbing. Curing, as specified elsewhere, shall be completed in all cases.

TABLE OF FINISHES

STRUCTURE	TYPE OF FINISH				
	PART	AREA	FLOAT	GROUT CLEAN DOWN	RUBBED
_____ BRIDGE	Abutment	Exposed		X	
	Wings	Top	X		
		Exp Sides		X	
	Piers	Top	X		
		Exp Sides		X	
		Top	X		
		Sides			X
	Median		X		
	Seat		X		
	Bearing Areas*		X		
	Sidewalks	Top	X		
	Curbs	Top	X		
		Sides			X
BOX CULVERT	Wings	Top	X		
		Exp Sides		X	
	Curbs	Top	X		
		Sides			X
	Ends	Exp		X	
	Median		X		
	Parapets & Fascia	Top	X		
		Sides			X
CATCH BASINS**		Exp			X
CURBING			X		
DROP INLETS**		Exp			X
ENDWALLS		Top	X		
		Exp		X	
GUTTERS		Exp	X		
PRECAST PILES***		Exp			X
RETAINNG WALLS		Top	X		
		Exp		X	
SHOTCRETE		Exp	X		
SLOPE PAVING		Exp	X		
STEPS & COPING		Top	X		
		Exp Sides			X

* See Subarticle 300000-6.01.03-14 for finish following floating.
** Precast units excepted; See Subarticle M.08.02-4.
*** When required.

16. Testing Apparatus and Test Specimens:

(a) The flexural strength of the concrete for structures shall be monitored by the evaluation of compressive strength cylinders. The compressive strength specimens shall be cast and cured in the field in accordance with AASHTO T 23. After proper curing, these cylinders shall be transported to the Division of Materials Testing for strength evaluation.

(b) Cylinders for 28-Day Compressive Strength: The concrete necessary to cast several cylinders for 28-day compressive-strength determinations shall be furnished by the Contractor from each day's pour. The necessary personnel and forms for casting these specimens will be furnished by the Department and the number of specimens required will be specified by the Engineer. These cylinders shall be cured in an approved concrete cylinder box, or boxes, as described in Section 300000-6.12.

17. Opening to Traffic: Vehicular traffic shall be excluded from the structure until the concrete has developed a compressive strength of 4,000 psi (28 megapascals), or until the Engineer authorizes its opening to traffic. Use of equipment applying loads greater than the design capacity of the bridge or structure shall not be allowed.

18. Joint Seal: The Contractor shall seal joints where shown on the plans and elsewhere where directed by the Engineer. Before placement of the sealing material, the joints shall be thoroughly cleaned of all scale, loose concrete, dirt, dust or other foreign matter. Projections of concrete into the joint space shall be removed. The joint shall be clean and dry before the sealing compound is applied.

The joint sealant shall be prepared and placed in accordance with the manufacturer's directions and with the equipment prescribed by the manufacturer. Any material improperly mixed or likely to set up before placement into the joints will be rejected and shall be replaced at the Contractor's expense.

The joints shall be sealed in a neat and workmanlike manner, free from all dust and foreign matter.

When the work is completed, the joints shall effectively seal against infiltration of moisture and water.

The sealing compound shall be flush with, or not more than 1/8 inch (3 millimeters) above the adjacent

surface of concrete. Where directed by the Engineer, the joint shall be smoothed and leveled to the adjacent surface by cutting off all excess compound after the application. Any joint material which does not adhere or bond with the concrete surface of the joint shall be immediately removed and replaced at the Contractor's expense.

SECTION 6.02 REINFORCING STEEL

6.02.01—Description:

Work shall consist of furnishing and placing reinforcing steel and splicing materials, of the type and size designated, as shown on the plans, as directed by the Engineer and in accordance with these specifications.

6.02.02—Materials:

The materials for this work shall conform to the requirements of Article M.06.01.

6.02.03—Construction Methods:

1. Shop Drawings: Prior to fabricating any materials, the Contractor shall submit shop drawings of the reinforcing steel and splicing materials, with material lists, material designations, placement diagrams, bending diagrams and manufacturer's literature for mechanical connections, for review and approval, in accordance with Article 1.05.02. Any expenses incidental to the revision of materials furnished in accordance with shop drawing and order lists to make them comply with the requirements of the plans or specifications shall be borne by the Contractor.

2. Fabrication:

(a) Cutting and Bending: Bar reinforcement shall be cut and bent to the shapes shown on the plans. Fabrication tolerances shall be in accordance with the requirements of ACI 315. All bars shall be bent cold, unless otherwise permitted.

Coated bars shall not be field cut, unless permitted by the Engineer. Field cutting of coated bars should be performed using hydraulic-powered cutters or friction cutting tools to minimize coating damage and field touch-up. Flame cutting of coated bars will not be permitted. Field cut coated bars shall be repaired immediately.

Bars partially embedded in concrete shall not be field bent, except as shown on the plans or permitted by the Engineer.

(b) Hooks and Bend Dimensions: The dimensions of hooks and the diameters of bends measured on the inside of the bar shall be as shown on the plans. When the dimensions of hooks or the diameter of bends are not shown, they shall be in accordance with the ACI 318, "Building Code Requirements for Reinforced Concrete" as amended by ASTM A767M for galvanized bars.

(c) Identification: Bar reinforcement shall be shipped in standard bundles, tagged and marked in accordance with the CRSI "Manual of Standard Practice".

3. Handling, Storing and Surface Condition of Reinforcement: Steel reinforcement shall be stored above the surface of the ground on platforms, skids, or other supports and shall be protected as far as practical from mechanical injury and surface deterioration caused by exposure to conditions producing rust.

Epoxy-coated and galvanized reinforcing steel shall be handled and stored by methods that will not damage the coating. All systems for handling coated reinforcement shall have adequately padded contact areas wherever possible. All bundling bands shall be padded and all bundles shall be lifted with a strong

back, multiple supports, or platform bridge so as to prevent bar-to-bar abrasion from sags in the bar bundle. Bars or bundles shall not be dropped or dragged. Coated reinforcing steel shall be transported and stored on wooden or padded supports. Epoxy-coated reinforcing steel, stored at the job site, shall be protected by covering with opaque polyethylene or other suitable protective material. Provisions shall be made for adequate ventilation to prevent condensation under the covering. Since the epoxy coating is flammable, the epoxy coated reinforcing shall not be exposed to any fire or flame.

Prior to placement of concrete, all reinforcement shall be free from dirt, loose rust or scale, mortar, paint, grease, oil, or other materials that would reduce bond. Reinforcement shall be free from injurious defects such as cracks and laminations. Bonded rust, surface seams, surface irregularities, or mill scale will not be cause for rejection, provided the minimum dimensions, cross section area, and tensile properties of a hand wire brushed specimen meet the physical requirements for the size and grade of steel specified.

4. Placing and Fastening

(a) General: Steel reinforcement shall be accurately placed as shown on the plans and firmly held in position during the placing and setting of concrete. Bars shall be tied at all intersections except where the spacing is less than 12 inches (300 millimeters) in each direction when alternate intersections shall be tied.

Bars shall be tied at all intersections around the perimeter of each mat.

Bundled bars shall be tied together at not more than 6-foot (1800-millimeter) centers. Lap splices shall have a minimum of 2 ties or be tied 12 inches (300 millimeters) apart for the length of the splice, whichever requires the greater number of ties. For epoxy-coated reinforcement, tie wires and metal clips shall be epoxy, plastic or nylon coated. For galvanized reinforcement, tie wires and metal clips shall be plastic coated or galvanized.

With the exception of tie down bars, welding (tack welding) will not be permitted for assembly of reinforcement, unless shown on the plans. Tie down bars shall be placed as shown on the plans and a top longitudinal reinforcing bar tied to these bars. When welding coated bars an appropriate protective mask must be worn, safety equipment used and suitable ventilation provided.

If wire fabric reinforcement is shipped in rolls, it shall be straightened into flat sheets before being placed.

(b) Support Systems: Reinforcing steel shall be supported in its proper position by use of precast mortar blocks, wire bar supports, supplementary bars (tie-down bars), side form spacers or other approved devices. Such devices shall be sufficiently strong and properly placed at frequent intervals so as to maintain the cover between the reinforcing and the surface of the concrete. The reinforcing steel cover shall be no less than that shown on the plans and no greater than that shown plus 1/4 inch (6 millimeter).

Platforms for the support of workers and equipment during concrete placement shall be supported directly on the forms and not on the reinforcing steel.

(c) Precast Mortar Blocks: Precast mortar blocks shall have a compressive strength not less than that of the concrete in which they are to be embedded. The face of the blocks in contact with forms for exposed surfaces shall not exceed 2 inches x 2 inches (50 millimeters x 50 millimeters) in size and shall have a color and texture that will match the concrete surface. Precast mortar blocks shall not be used on exposed surfaces of precast concrete members. When used on vertical or sloping surfaces, such blocks shall have an embedded wire for securing the block to the reinforcing. When used in slabs, either such a tie wire or, when the weight of the reinforcing is sufficient to firmly hold the blocks in place, a groove in the top of

the block may be used. For epoxy-coated bars, such tie wires shall be epoxy, plastic or nylon coated. For galvanized bars, such tie wires shall be plastic coated or galvanized.

(d) Wire Supports: Wire bar supports, such as ferrous metal chairs and bolsters, shall conform to industry practice as described in the CRSI "Manual of Standard Practice of the Concrete Reinforcing Steel Institute." All bolsters or chairs which bear against the forms for exposed surfaces shall be equipped with snug fitting, high density, polyethylene tips which provide 1/2-inch (12-millimeter) minimum clearance between the metal and any exposed surface. For epoxy-coated reinforcement, all wire bar supports and bar clips shall be epoxy or plastic coated. For galvanized reinforcement, chair and bar supports shall be hot-dip galvanized, after fabrication, in accordance with ASTM A123.

The maximum spacing of slab bolster rows and high chair rows for concrete deck slabs shall be 4 feet (1200 millimeters) unless otherwise directed by the Engineer.

(e) Repair of Coated Reinforcing Steel:

Epoxy-coated Reinforcing Steel - In addition to the requirements of ASTM D3963M, all damage (i.e., scratches, nicks, cracks) to the epoxy coating of the bar reinforcement, visible to the unaided eye with corrective vision, caused during shipment, storage or placement shall be repaired by the Contractor at the job site with approved patching material. Ends of bars that have been sheared, saw cut or cut by other means shall be coated with approved patching material. The areas on the bars and tie down bars damaged by welding shall be repaired with approved patching material.

Patching of damaged areas shall be performed in accordance with the patching material manufacturer's recommendations. Any singular damaged surface area (prior to repair with approved patching material), shall not exceed 2% of the total surface area of the bar. The total bar surface area covered by patching material shall not exceed 5% of the total surface area of the bar. Should either of these limits be exceeded the bar shall be removed from the work and replaced with an acceptable bar. All patching material shall be fully cured prior to placing concrete.

The patching material shall be compatible with the epoxy coating, inert in concrete, and suitable for repairs in the field. The patching material shall be prequalified, as required for the coating material, and shall be either identified on the container as meeting the requirements of Annex A1 of ASTM D3963M or shall be accompanied by a Materials Certificate certifying that the material meets the requirements of said Annex A1.

Galvanized Reinforcing Steel - All damage (i.e. scratches, nicks, cracks) to the galvanized coating on bar reinforcement, visible to the unaided eye with corrective vision, caused during shipment, storage or placement shall be repaired by the Contractor at the job site in accordance with ASTM A780, Annex A2 - "Repair using Zinc-Rich Paints". Ends of bars that have been sheared, saw cut or cut by other means shall be coated with zinc-rich paint. The area on the bars and tie down bars damaged by welding shall be repaired with zinc-rich paint.

Field coating of damaged areas shall be performed in accordance with the zinc-rich paint manufacturer's recommendations. The zinc-rich paint shall conform to FS TT-P-641, Type 1 and shall be brush applied to achieve a dry film thickness from 3 - 6 mils. All touchup paint shall be fully cured prior to placing concrete.

5. Splicing of Bars:

(a) General: All reinforcement shall be furnished in the full lengths indicated on the plans unless otherwise permitted. Except for splices shown on the plans, splicing of bars will not be permitted without written approval of the Engineer. Splices shall be staggered as far as possible.

(b) Lapped Splices: Lapped splices shall be of the lengths shown on the plans. In contact lap splices, the bars shall be placed in contact and tied together in such a manner as to maintain the minimum distance to the surface of the concrete shown on the plans.

In non-contact lap splices, the bars shall be placed as shown on the plans and tied to adjacent bars in such a manner as to maintain the minimum distance to the surface of the concrete shown on the plans.

(c) Welded Splices: Welded splices shall be used at the locations shown on the plans. Welding shall conform to AWS publication "Structural Welding Code, Reinforcing Steel, AWS D1.4"

Welded splices shall not be used on epoxy-coated or galvanized bars. No welding shall be performed close enough to epoxy-coated or galvanized bars to cause any heating of the coating.

(d) Splices made with Dowel Bar Mechanical Connections: Splices made with dowel bar mechanical

connections shall be used at the locations shown on the plans. The minimum size of the bars and the length of the lap splices for the dowel bar mechanical connections shall be as shown on the plans.

The mechanical connections shall be installed in accordance with the manufacturers recommendations. All tools and equipment required to install and field inspect the connections shall be provided by the Contractor. The Contractor shall take all measures necessary to prevent concrete from adhering to the threaded portions of the mechanical connections.

After installing the coated mechanical connectors, all damaged areas on the coated connectors shall be repaired in accordance with Section 300000-6.02.03-4(e).

6. Splicing of Welded Wire Fabric: Welded wire fabric reinforcement shall be lap spliced as shown on the plans.

7. Substitutions: Substitution of different size bars will be permitted only when authorized by the Engineer. The substituted bars shall have an area equivalent to or larger than the area shown on the plans.

8. Inspection: Reinforcement in any member or component shall be placed, inspected and approved by the Engineer before placing of concrete begins. Concrete placed prior to approval of the reinforcement may be rejected and its removal required.

SECTION 6.51 CULVERTS

6.51.01—Description:

Work shall consist of furnishing and installing new pipe culverts, new pipe-arch culverts and relaying existing pipe and pipe-arch culverts of the type, size and length called for on the plans or as ordered, at the locations and to the lines and grades designated on the plans, or as directed by the Engineer, and in conformity with these specifications. Work shall also consist of furnishing and installing slotted drain pipes to the dimensions, details and of the size, length and location shown on the plans or ordered by the Engineer.

Work shall also include furnishing and installing culverts, either circular or arched, composed of structural plates, fabricated in the field in accordance with the details shown on the plans, or as ordered. Substructures and incidental construction shall comply with the requirements of the specifications for the various elements which constitute the completed structure.

Work shall further include the furnishing and installing of corrugated metal pipe elbows of the type and size shown on the plans, at the location, to the lines and grade designated, or as ordered by the Engineer and in conformance with these specifications.

6.51.02—Materials:

The materials for this work shall conform to the following: Pipes of the type indicated on the plans and joint sealant shall conform to the requirements of Article M.08.01. Bedding material shall conform to the requirements of Article M.08.03. Granular fill shall conform to the requirements of Article M.02.01.

6.51.03—Construction Methods:

Unless otherwise directed by the Engineer, all new or re-laid pipe culverts, including culverts composed of structural plates, shall be installed in pipe bedding in accordance with the details as shown on the plans and in conformance with these specifications.

Pipe with an internal diameter of less than 48 inches (1200 millimeters) and pipe-arch of an equivalent horizontal span shall be installed in a Type I installation, and pipe of 48 inches (1200 millimeters) internal diameter or more, including pipe-arch of equivalent horizontal span shall be installed in a Type II installation.

Type I installation shall consist of installing the pipe, or pipe-arch, in bedding material with a thickness directly under the pipe of 4 inches (100 millimeters) and pre-shaped to a height of 10% of the total height of the pipe. After the pipe has been installed, the trench shall be backfilled with bedding material to a height of 25% of the total height of the pipe.

Type II installation shall consist of installing the pipe or pipe-arch in bedding material, with a thickness directly under the pipe of 4 inches (100 millimeters) and pre-shaped to a height of 10% of the total height of the pipe. After the pipe has been installed, the trench shall be backfilled with bedding material to a height of 12 inches (300 millimeters) above the top of the pipe.

Methods of backfilling shall be in conformance with the pertinent sections of Article 300000-2.05.03. Where pipe is to be laid below the ground line, a trench shall be excavated to the required depth, the bottom of which shall be graded to the elevation of the bottom of the bedding material or to afford a uniform firm bearing for the pipe throughout its entire length, whichever the case may be. When rock is encoun-

tered, it shall be excavated to not less than 12 inches (300 millimeters) below the bottom of the pipe; and this depth shall be refilled with bedding material which shall be thoroughly tamped.

Where pipe is to be laid in a fill area, the embankment shall be placed and compacted to an elevation 12 inches (300 millimeters) above the top of the proposed pipe, whereupon the trench excavation shall be made and the pipe installed.

Where the nature of the foundation is poor, the culvert shall be relocated in firm material if possible. Where this cannot be done, the poor material shall be removed and replaced with a layer of granular fill of such depth as the Engineer may direct; or special construction of the character shown on the plans, or as ordered by the Engineer, may be employed.

Normally, the placement of pipe shall start at the downstream end and progress upstream. All pipe shall be carefully laid, true to the lines and grades given, hub ends upgrade and with the spigot ends fully entered into the adjacent hubs.

Joints in concrete and vitrified clay pipe shall be sealed with either cold-applied bituminous sealer, preformed plastic gaskets or flexible, watertight, rubber-type gaskets conforming to the requirements of Article M.08.01. Portland cement mortar shall not be used for sealing pipe joints except by permission of the Engineer, and if permitted shall conform to the requirements of Article M.11.04.

When cold-applied bituminous sealer is used, the bell and spigot or tongue and groove pipe shall be wiped clean and dry before applying the bituminous sealer to the pipe joint. Before the pipes are placed in contact with each other, the spigot or tongue end shall be completely covered with an excess of bituminous sealer; then the pipe shall be laid to line and grade so the inside surface of the abutting pipes are flush. The joints shall be completely filled with bituminous sealer. All excess joint sealant shall be removed from inside of the pipe.

Metal pipe and pipe-arches shall be carefully jointed and firmly clamped together by approved connecting bands, which shall be properly bolted in place before any backfill is placed.

Corrugated structural plate pipe, plate-arches and plate pipe-arches shall be constructed in conformity with the plans, or as ordered, shall be true to lines and grades given, and shall have a protective bituminous coating applied by an approved method on the inside and outside of the plates. The coating material shall meet the requirements of Subarticle M.08.01-5. Before applying the coating, the metal shall be cleaned to the extent possible of all dust, dirt, oil, unbonded or incompatible paint, grease, acids, alkalies or other foreign matter.

If so ordered by the Engineer, any pipe which is not in true alignment, or which shows any settlement or distortion after laying, shall be taken up and re-laid or corrected, to the satisfaction of the Engineer without additional compensation.

Where indicated on the plans or directed by the Engineer, existing pipe culverts shall be taken up and relaid or extended and renewed in the same manner as specified herein for new pipe culverts.

Where shown on the plans or directed by the Engineer, the Contractor shall connect the proposed drainage system with existing drainage structures or pipes. This work shall be performed in a workmanlike manner.

Where shown on the plans or directed by the Engineer, the Contractor shall plug existing pipes with cement masonry.

For Slotted Drain Pipe: All slotted drain pipe and related fittings shall be handled and assembled in accordance with the manufacturer's instructions except as modified in the contract documents or as ordered by the Engineer.

Placement of concrete shall conform to Article 300000-6.01.03. The Contractor shall ensure all voids are filled with the concrete.

Care shall be taken in placing concrete backfill immediately adjacent to the interceptor drain pipes to avoid damage to the pipe and to prevent pipe misalignment. The concrete shall be thoroughly consolidated using internal vibrators. Sufficient hold-downs shall be provided by the Contractor to prevent the interceptor drain from floating during concrete placement.

The Contractor shall make sure the surface of the concrete shall be sloped towards the slotted drain pipe detailed in the contract documents. The Contractor shall provide a suitable cover for the wall openings to prevent the concrete backfill or any other foreign debris from entering the pipe or sealing the opening during the installation and subsequent curing periods.

Transverse contraction joints shall be either formed or sawed in the concrete backfill at 20-foot (6-meter) intervals unless the concrete abuts concrete curbs. In this case, the transverse joints shall be 3/8 inch (9 millimeters) wide and 2 1/2 inches (65 millimeters) deep. Sawing shall be done within 24 hours after placement. Care shall be taken not to saw into the interceptor drain pipe.

One expansion joint shall be provided in the concrete backfill for every 500 feet (150 meters) of continuous interceptor drain pipe installed or at every location where the concrete backfill abuts a drop inlet, manhole, or other similar structure. This joint shall be formed for the full depth of the backfill concrete and shall be a minimum of 3/4 inch (19 millimeters) in width.

A longitudinal joint shall be provided if the concrete backfill is placed adjacent to a concrete pavement. This joint shall be either formed or sawed 1/4 inch (6 millimeters wide) and 2 1/2 inches (65 millimeters) deep. Finish of concrete will be similar to burlap drag finish.

After curing, the transverse, expansion, and longitudinal joints shall be thoroughly cleaned to remove any contaminants or laitance remaining from forming or saw cutting. Before sealing, a backer rod bond breaking material such as closed cell polyurethane rod shall be placed so that a sealer width to depth ratio of 1:1 will be achieved. The joints shall then be sealed with an elastomeric polymer sealer. The methods and materials used to construct the various joints shall be chosen by the Contractor subject to the approval by the Engineer.

Movement of construction equipment and all other vehicles and loads over and adjacent to any slotted drain pipe shall be done at the Contractor's risk. Any pipe or backfill which becomes damaged or disturbed through any cause shall be replaced or repaired as directed by the Engineer at the expense of the Contractor and at no cost to the State. Suitable temporary crossovers consisting of steel plate or other materials approved by the Engineer shall be employed for a minimum of 7 days following concrete backfill operations in all areas where vehicular traffic must be maintained or until such time as the pipe installation will withstand loading without damage. All concrete surfaces shall receive a protective coating.

End cap installation shall be as recommended by the manufacturer.

SECTION 6.52 CULVERT ENDS

6.52.01—Description:

Work shall consist of furnishing and installing reinforced concrete culvert ends conforming to the details shown on the plans or to commercial details providing equal lengths and a similar shape, and having generally comparable hydraulic characteristics. These reinforced concrete culvert ends shall be placed where and as shown on the plans, or as directed by the Engineer.

Work shall also include furnishing and installing new metal culvert ends at the locations shown on the plans or as directed by the Engineer. These culvert ends shall be of the size, gage and general shape shown on the plans.

6.52.02—Materials:

The materials for this work shall conform to Subarticle M.08.01-11 for Reinforced Concrete Culvert End, Subarticle M.08.01-6 for Metal Culvert End, Article M.11.04 for Mortar and Article M.02.01 for Gravel Fill.

6.52.03—Construction Methods:

Reinforced concrete culvert ends shall be placed on a prepared bed of the existing ground, or if so directed by the Engineer, on gravel fill and accurately aligned as shown on the plans. The joints shall be sealed as specified in Article 300000-6.51.03.

Metal culvert ends shall be placed on a prepared bed of the existing ground, or if so directed by the Engineer, on gravel fill. After the attachment of the culvert end to the culvert, backfill shall be placed around both sides of the unit up to the prescribed surface, exercising caution to avoid displacement or deformation of the unit.

SECTION 7.03 RIPRAP

7.03.01—Description:

Riprap shall consist of angular shaped stones used to protect foundations of piers, abutments, walls, slopes of embankments and waterways from water damage.

7.03.02—Materials:

1. Stone: The stone for this work shall be the type called for on the plans and shall conform to the requirements of Article M.12.02.

2. Bedding: The bedding material for riprap shall conform to the specifications of the material indicated on the plans.

7.03.03—Construction Methods:

The area to be protected by riprap shall be accurately shaped prior to placing of any bedding material or riprap. Where bedding material is called for, it shall be placed on the prepared area and compacted to the depth, lines and grades indicated on the plans.

The riprap shall be placed to its full course thickness in one operation in such a manner as to produce a reasonably well-graded mass of rock without causing displacement of the underlying material. The finished surface shall be free from pockets of small stones and clusters of larger stones. Placing this material by methods likely to cause segregation of the various sizes of stone will not be permitted. Rearranging of individual stones by mechanical or hand methods will be required to the extent necessary to obtain a reasonably well-graded distribution of the specified stone sizes. The completed course shall be of the specified thickness and to the lines and grades as shown on the plans or as ordered by the Engineer.

SECTION 7.08 DAMP-PROOFING

7.08.01—Description:

Damp-proofing of concrete or masonry work shall consist of a coating of asphalt as indicated on the plans and in accordance with these specifications.

7.08.02—Materials:

The materials for this work shall conform to the requirements of Article M.12.05.

7.08.03—Construction Methods:

The surface to which the damp-proofing coating is to be applied shall be cleaned of all loose and foreign material and dirt and shall be dry. Where necessary, the Engineer may require the surface to be scrubbed with water and a stiff brush, after which the surface shall be allowed to dry before the application of the primer.

Concrete, brick or other surfaces which are to be protected by damp-proofing shall be thoroughly clean and dry before the primer is applied. One (1) coat of primer and one (1) coat of sealer shall be applied using methods, application rates and temperature constraints as recommended by the manufacturer of each product.

Care shall be taken to confine all applied material to the areas to be damp-proofed and to prevent disfigurement of any other parts of the structure by dipping or spreading.

SECTION 7.51 UNDERDRAIN AND OUTLETS

7.51.01—Description:

Underdrains shall consist of pipe pervious to water, laid in a trench refilled with pervious material. They shall be of the dimensions and details as indicated on the plans. They shall be classed as "Underdrains," "Foundation Underdrains," "Slope Underdrains" or "Structure Underdrains."

Outlets for underdrains shall consist of pipe laid in a trench and refilled with earth. The size and type of outlet pipe shall be the same as that of the underdrain to which it is connected, except that it shall not be pervious to water.

7.51.02—Materials:

(1) Pipe: The pipe of underdrains and outlets shall conform to the requirements of Article M.08.01. The kind of pipe to be installed shall be at the option of the Contractor unless a specific type of pipe is indicated on the plans.

(2) Aggregates: The aggregates specified for filling the trench shall meet the requirements of Article M.08.03.

(3) Joint Sealants: The materials for sealing and coupling of joints shall conform to the requirements of Article M.08.01.

(4) Geotextile: Geotextile shall conform to Subarticle M.08.01-19 Geotextiles.

7.51.03—Construction Methods:

The trench for the underdrain shall be excavated in conformity with the requirements of Article 300000-6.51.03 for pipe culverts. The dimensions of the trench shall be as indicated on the plans or as ordered. Where the bottom of the trench is unstable or in rock, the trench shall be excavated 6 inches (150 millimeters) deeper and an additional 6 inches (150 millimeters) layer of granular fill or aggregate similar to that used to fill the trench shall be placed and compacted in the trench.

Where the perforations are to be at the bottom of the pipe, the aggregate for filling the trench shall then be placed to a depth of 3 inches (75 millimeters) and tamped true to grade. The pipe shall be placed and firmly bedded on the aggregate. This aggregate shall be placed whether the pipe is encased with geotextile or not.

When the pipe used has a bell, the pipe shall be installed with the bell end upgrade with the spigot end entered fully into the adjacent bell.

When clay or concrete pipe is used, the joints will not have to be filled with a joint sealant or fitted with a gasket.

When metal, bituminized fiber, plastic, polyethylene or asbestos cement pipe is used, the pipe shall be carefully butted together and held by bands or other approved means so as to prevent any displacement of the joint.

After the pipe has been installed as described above, the aggregate shall be placed carefully around and over the pipe to a height of 12 inches (300 millimeters) above the top of the pipe. The remainder of the

trench shall be filled with aggregate and tamped in layers as shown on the plans. When the underdrain pipe is used with the holes in an upward position, and in all cases where sand is used instead of the aggregate described hereinbefore, a protective 3-inch (75-millimeter) minimum layer of 3/8-inch (Size No. 8) aggregate shall be placed over the pipe and around all of the holes. Geotextile may be substituted for the 3- inch (75-millimeter) layer of aggregate. When geotextile is used, the entire length of each drain pipe shall be wrapped with the fabric and the seams lapped and welded or bonded. Where the seams of the geotextile are not welded or bonded, they shall be lapped to a minimum width equal to the diameter of the pipe for 6- inch (150-millimeter) pipe and larger and a minimum of 6 inches (150 millimeters) for smaller pipe.

In all cases where subbase material or gravel is to be placed over the underdrains, a layer of at least 6 inches (150 millimeters) of subbase material or gravel shall be placed over the underdrain immediately after its completion.

For outlets, the trench shall be excavated and the pipe installed in conformity with the requirements of Article 300000-6.51.03.

Where shown on the plans or directed by the Engineer, the Contractor shall connect underdrains or outlets to existing or proposed drainage systems or structures.

This work shall be performed in a workmanlike manner satisfactory to the Engineer by installation of tees or wyes branches or by providing a hole in the main line underdrain.

Where the upgrade end of the underdrain does not enter a structure, it shall be capped or plugged as directed.

SECTION 7.55 GEOTEXTILE

7.55.01—Description:

Work shall consist of furnishing and installing geotextile in the locations and to the dimensions shown on the plans as directed or as approved by the Engineer.

7.55.02—Materials:

Geotextile shall conform to the requirements of M.08.01-19 Geotextiles. Materials incidental to and necessary for the installation of the geotextile, such as, but not limited to sewing thread, staples, pins, etc., shall conform to the requirements of the manufacturer of the geotextile.

7.55.03—Construction Method:

The geotextile shall be installed at the locations and to the dimensions shown on the plans or as directed by the Engineer. Geotextile shall be installed as recommended by the manufacturer for the specific use or purpose intended, or as otherwise approved by the Engineer.

SECTION 8.11 CONCRETE CURBING

8.11.01—Description:

Work shall consist of concrete curbing constructed on the prepared subbase in accordance with the dimensions and details shown on the plans or as ordered and in conformity with these specifications.

Refer to Division 01, High Performance Buildings Requirements Section 018113.13 for credit 16a-38k-4(d)9 and 16a-38k-4(d)11.

The above listed HPB credit is related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

8.11.02—Materials:

The concrete for cast-in-place or slip formed curbing shall be Class "C" concrete conforming to the requirements of Article M.03.01. Joint filler shall conform to the requirements of Article M.03.01. The concrete for precast concrete curbing shall have a minimum 28-day compressive strength of 4,000 psi (28 megapascals) and shall contain 5 to 7% entrained air unless otherwise approved by the Engineer. The material for the precast concrete shall conform to Article M.03.01, except the coarse aggregate gradation may be varied with the approval of the Engineer.

8.11.03—Construction Methods:

Construction methods for concrete curbing shall conform to the requirements of Article 300000-6.01.03 for concrete for structures, as supplemented by the following requirements:

1. Excavation: Excavation shall be made to the required depth, and the base upon which the curbing is to be set shall be compacted to a firm, even surface.

2. Placing of Concrete: The concrete shall contain not less than 5% nor more than 7% entrained air at the time the concrete is deposited within the forms. Concrete shall be placed only on a moist base. Concrete shall not be placed on a soft, muddy or frozen base.

Slip form equipment may be used if the resulting product conforms with the plans. Precast concrete curbing may be used if the resulting product conforms with the plans except for the length of each curb unit. Precast concrete curbing units shall be constructed in 6-foot (2-meter) or longer lengths for straight sections.

Where slip form equipment or precast concrete curbing is not used, the concrete shall be placed in forms, struck off with a template, compacted by approved means, and finished to a smooth, even surface. Vibration will not be required.

The concrete curbing shall be constructed in sections having a uniform length of approximately 10 feet (3 meters), unless otherwise directed, so arranged that a joint in the curbing shall come opposite a joint in the adjoining concrete pavement slab and be similar to it. The length of these sections may be varied slightly where necessary for closures, but no section less than 6 feet (2 meters) in length will be permitted. These sections shall be separated by an approved method at the time of placing of the concrete.

3. Forms: Where forms are used, they shall be so constructed that the form for exposed faces may be removed before the concrete has taken final set in order to permit correction of surface irregularities.

4. Curing and Protection: Concrete curbing, except precast curbing, shall be cured and protected in conformity with the requirements of Article 300000-4.01.03 for concrete pavement. Precast curbing shall not be shipped to the project until the 28-day compressive strength is acquired. Precast curbing that has been damaged shall be removed from the project at the Contractor's expense.

5. Backfilling: After the concrete has set sufficiently, the grading shall be completed to the lines shown on the plans, or as ordered, by refilling to the required elevation with approved material which shall be placed in layers of not over 6 inches (150 millimeters) in depth and compacted until firm and solid.

SECTION 9.13 CHAIN LINK FENCE

9.13.01—Description:

Work shall consist of furnishing and installing woven wire fencing and gates of the type and height specified and supported by metal posts erected where indicated on the plans or as ordered and in conformity with these specifications.

9.13.02—Materials:

The materials for this work shall conform to the requirements of Article M.10.05.

When aluminum-coated steel fabric is used, the posts and hardware will be galvanized.

When aluminum fabric is used, the posts and hardware will be aluminum.

When polyvinyl chloride-coated steel fabric is used, the posts and hardware will be polyvinyl chloridecoated.

Where the term "Chain Link Fence" is called for, the Contractor shall have the option of using either aluminum chain link fence or aluminum-coated chain link fence. However, only one type of chain link fence shall be used on the project.

9.13.03—Construction Methods:

The posts shall be spaced in line of fence not further than 10 feet (3meters) on centers. Intermediate or line posts, except where indicated on the plans, may be driven by mechanical means. A suitable driving cap shall be used to insure that no damage is caused to the post, galvanization or polyvinyl chloride coating. Posts not driven, and all other type posts shall be set in portland cement concrete acceptable to the Engineer.

In earth, the hole for the concrete footing shall extend at least 4 inches (100 millimeters) below the bottom of the post but not less than 9 inches (225 millimeters) in diameter for all line posts and 12 inches (300 millimeters) in diameter for terminal, pull or corner posts. The tops of the concrete footings shall be crowned to shed water.

When ledge rock is encountered, the posts shall be set in holes drilled into rock at least 12 inches (300 millimeters) in depth and grouted or otherwise firmly held in correct position.

For fence 5 feet (1.5 meters) in height or less where runs of fence are 100 feet (30 meters) or over, end posts shall be braced. All corner posts where runs are over 100 feet (30 meters) in either direction shall have two braces. For fence more than 5 feet (1.5 meters) in height, end posts shall be braced; and corner posts shall have two braces.

Pull posts with two braces shall be provided for all heights where changes in horizontal or vertical alignment of ten (10) degrees or more occur.

Where braces are required, they shall be spaced as indicated on the plans.

Braces shall be securely fastened to posts by suitable connections and trussed from line post back to post requiring bracing with 3/8-inch (9.5-millimeter) round rod, having a turnbuckle adjustment.

Where a top rail is used, it shall pass through the base of the line post cap and form a continuous brace from end to end of fence. The rail shall be provided with couplings approximately every 20 feet (6 meters).

The couplings shall be of the outside-sleeve type and at least 7 inches (175 millimeters) long, one coupling in every five to have a heavy spring to take up expansion and contraction in the top rail.

Fabric shall be fastened to line posts with bands or wire clamps of No. 6-gage aluminized or PVC coated steel wire 4 3/4 inches (120 millimeters) long. These bands shall be spaced approximately 14 inches (350 millimeters) apart. The fabric shall be fastened to the top rail with tie wires. These tie wires shall be 6 1/4 inches (160 millimeters) long, spaced approximately 24 inches (600 millimeters) apart.

If a top rail is not specified, a top tension wire shall be provided. The tension wire shall be one continuous length between pull posts. Sufficient tension shall be applied to provide a wire without a visible sag between posts. Tension wires shall be tied or otherwise fastened to end, gate, corner or pull posts by a method acceptable to the Engineer. Ties or clips shall be provided for attaching the tension wire to the fabric at intervals not exceeding 2 feet (600 millimeters).

Where it is not practicable to conform the fence to the general contour of the ground, as at ditches, channels, etc., the opening beneath the fence shall be enclosed with chain link fabric and sufficiently braced to preclude access, but not to restrict the flow of water.

Fabric shall be fastened to the end of the gate frames by stretcher bars and fabric bands, and to the top and bottom of the gate frames by tie wires in the same manner as specified for the chain link fence fabric.

The drop bar locking device for the gate shall be provided with a footing of portland cement concrete crowned at the top to shed water and provided with a hole to receive the locking bar. A heavy-duty padlock with 2 keys shall be furnished by the Contractor for each gate or set of double gates. The size of the footing and depth of penetration of the locking bar into the footing shall be as specified by the manufacturer of the locking device.

SECTION 9.21 CONCRETE SIDEWALKS

9.21.01—Description:

Work shall consist of concrete sidewalks constructed on a gravel or reclaimed miscellaneous aggregate base course in the locations and to the dimensions and details shown on the plans or as ordered and in accordance with these specifications.

9.21.02—Materials:

Materials for this work shall conform to the requirements of Article M.03.01 for Class "C" Concrete.

Air-entraining Portland cement and air-entraining admixtures shall conform to Article M.03.01

Gravel or reclaimed miscellaneous aggregate for base shall conform to Article M.02.01 for granular fill.

The concrete sidewalk constructed as a pad adjacent to a traffic control foundation, shall conform to the requirements of Article M.03.01 for Class "A" Concrete.

9.21.03—Construction Methods:

1. Excavation: Excavation, including removal of any existing sidewalk, shall be made to the required depths below the finished grade, as shown on the plans or as directed. All soft and yielding material shall be removed and replaced with suitable material.

When connecting new concrete sidewalk to a section of existing concrete sidewalk, the connection point shall be at the nearest joint in the existing sidewalk.

2. Gravel or Reclaimed Miscellaneous Aggregate Base: The gravel or reclaimed miscellaneous aggregate base shall be placed in layers not over 6 inches (150 millimeters) in depth and to such a depth that after compaction it shall be at the specified depth below the finished grade of the walk. The base shall be wetted and rolled or tamped after the spreading of each layer.

3. Forms: Forms shall be of metal or wood, straight, free from warp and of sufficient strength to resist springing from the pressure of the concrete. If made of wood, they shall be of 2-inch (38-millimeter) surfaced plank except that at sharp curves thinner material may be used. If made of metal, they shall be of approved section and shall have a flat surface on the top. Forms shall be of a depth equal to the depth of the sidewalk. Forms shall be securely staked, braced and held firmly to the required line and grade and shall be sufficiently tight to prevent leakage of mortar. All forms shall be cleaned and oiled or wetted before concrete is placed against them. Sheet metal templates 1/8 inch (3 millimeters) in thickness, of the full depth and width of the walk, shall be spaced at intervals of 12 feet (4 meters) or as directed. If the concrete is placed in alternate sections, these templates shall remain in place until concrete has been placed on both sides of the template. As soon as the concrete has obtained its initial set, the templates shall be removed.

4. Concrete: The concrete shall be proportioned, mixed, placed, etc., in accordance with the provisions of Section 6.01 for Class "C" Concrete, except as modified herein.

The concrete shall contain not less than 5% or more than 7% entrained air at the time the concrete is deposited in the forms.

Air-entrainment shall be obtained and the concrete cured in accordance with the provisions of Article 300000-4.01.03 for Concrete Pavement.

5. Finishing: The surface of the concrete shall be finished with a wood float or by other approved means. The outside edges of the slab and all joints shall be edged with a 1/4-inch (6-millimeter) radius edging tool. Each slab shall be divided into two or more sections by forming dummy joints with a jointing tool as directed.

6. Backfilling and Removal of Surplus Material: The sides of the sidewalk shall be backfilled with suitable material thoroughly compacted and finished flush with the top of the sidewalk. All surplus material shall be removed and the site left in a neat and presentable condition to the satisfaction of the Engineer.

SECTION 9.39 SWEEPING FOR DUST CONTROL

9.39.01—Description:

Work shall consist of furnishing a pickup sweeper and accessory equipment and utilizing it for the removal of earth and/or other dust producing materials from paved surfaces for the purpose of allaying dust conditions.

9.39.03—Construction Methods:

The Contractor shall have available and maintain in operable condition equipment capable of efficiently sweeping up earth and/or other materials from paved surfaces.

This equipment shall include suitable provisions for the application of water ahead of the sweeping brooms to prevent dusting, for the pickup, internal storage and removal of sweepings, and for the cleaning of areas of heavy accumulation beyond the capacity of the sweeper.

The sweeping operations shall be under the control of the Engineer at all times. Sweeping shall take place at locations and times directed by the Engineer. The disposal of all sweepings shall meet with the approval of the Engineer.

SECTION 9.43 WATER FOR DUST CONTROL

9.43.01—Description:

Work shall consist of furnishing water equipment, water, and applying it for the purpose of allaying dust conditions.

9.43.03—Construction Methods:

The application of water shall be under the control of the Engineer at all times. It shall be applied only at locations at such times, and in the amount as may be directed by the Engineer.

The Contractor shall have available and maintain in an operable condition at all times, sufficient equipment for the purpose of applying water for dust control. This equipment shall consist of pipelines, tanks, tank-trucks, pumps, meters, hose, distributors or other devices approved by the Engineer. A suitable device for a positive shutoff and for regulating the flow of water shall be located so as to permit positive operator control.

SECTION 9.44 TOPSOIL

9.44.01—Description:

This work shall consist of furnishing, placing and shaping topsoil in areas shown on the plans or where directed by the Engineer. The topsoil shall be placed to a depth of 4 inches (100 mm) unless stated otherwise in the contract.

Division 01, High Performance Buildings Requirements Section 018113.13 for credit 16a-38k-4(d)9 and 16a-38k-4(d)11 .

The above listed HPB credit is related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

9.44.02—Material:

The material shall conform to the requirements of Subarticle M.13.01-1.

9.44.03—Construction Methods:

The Contractor shall notify the Engineer of the location of the topsoil at least 15 calendar days prior to delivery. The topsoil and its source shall be inspected and approved by the Engineer before the material is delivered to the project. Any material delivered to the project, which does not meet specifications or which has become mixed with undue amounts of subsoil during any operation at the source or during placing and spreading, will be rejected and shall be replaced by the Contractor with acceptable material at no cost to the State.

The areas on which topsoil is to be placed shall be graded to a reasonably true surface. Topsoil shall then be spread and shaped to the lines and grades shown on the plans, or as directed by the Engineer. The required depth to which the topsoil is to be placed is to be the depth after settlement of the material has taken place. All stones, roots, debris, sod, weeds and other undesirable material shall be removed. After shaping and grading, all trucks and other equipment shall be excluded from the topsoiled area to prevent excessive compaction. The Contractor shall perform such work as required to provide a friable surface for seed germination and plant growth prior to seeding.

During hauling and spreading operations, the Contractor shall immediately remove any material dumped or spilled on the shoulders or pavement.

It shall be the Contractor's responsibility to restore to the line, grade and surface all eroded areas with approved material and to keep topsoiled areas in acceptable condition until the completion of the construction work.

SECTION 9.49 FURNISHING, PLANTING AND MULCHING TREES, SHRUBS, VINES AND GROUND COVER PLANTS

9.49.01—Description:

The work shall consist of furnishing, planting and mulching trees, shrubs, vines and ground cover plants of the type and size indicated on the plans. It shall also include all incidental operations, such as the care of the living plants and the replacement of dead and unsatisfactory plants or unsatisfactory materials before final acceptance of the contract.

Division 01, High Performance Buildings Requirements Section 018113.13 for credit 16a-38k-4(d)9 and 16a-38k-4(d)11 .

The above listed HPB credit is related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

9.49.02—Materials:

The material for this work shall conform to the requirements of Section M.13.

9.49.03—Construction Methods:

Construction methods shall be performed in accordance with these specifications.

The Contractor is cautioned that within the limits of any project, buried cable for illumination or utilities, which may be energized, may be present.

1. Planting Season: Unless otherwise shown on the plans or directed by the Engineer, the planting seasons shall be those indicated below. No planting shall be done in frozen ground or when snow covers the ground, or the soil is otherwise in an unsatisfactory condition for planting.

Deciduous Material

Spring: March 1st to May 1st (inclusive) except for balled and burlapped material, the planting of which will terminate on May 15th.

Fall: From October 15th until the ground freezes. Such plants, as may be designated elsewhere in the contract documents, shall be planted in the spring planting season only.

Evergreen Material

Spring: March 1st to June 1st (inclusive).

Fall: August 15th to October 1st (inclusive).

2. Protection: Plants received by the Contractor shall be kept moist, fresh and protected against exposure to sun, wind and freezing temperatures whether in the receiving yard, in transit, while being handled or in temporary storage on the job site awaiting planting. Bare-root plants, which are not planted immediately upon receipt, shall be heeled-in in trenches with the bundles opened, the plants separated and all roots covered so as to leave no air spaces. Balled and burlapped plants shall have their earth balls covered by earth, wood chips, cloth, straw or other suitable material which shall be kept moist.

3. Layout: Plant material locations and bed outlines will be staked on the project site by the Engineer-Designer or his designee in the presence of the Contractor, or his representative, before any plant pits or beds are excavated. Request by the Contractor for the staking of the plant layout shall be at least 48 hours, excluding weekends and holidays, prior to the date he wishes to have the layout staked. Labor, equipment and new, smooth stakes of approved quality are to be furnished by the Contractor for this purpose.

4. Excavation: Excavation for planting beds and pits shall conform to the approved staked locations and outlines. The latter shall be neatly formed by means of spades or other approved tools. All sod, weeds, roots and other objectionable material excavated from the plant beds or pit sites which are unsuitable for backfill shall be removed from the site immediately and disposed of by the Contractor in a manner satisfactory to the Engineer.

The Contractor at his option may apply, prior to excavating plant pits in designated planting bed locations, at no expense to the State, a post-emergent aqueous spray treatment of Glyphosate (isopropylamine salt of glyphosate) 41% acid equivalent (ae) to the existing bed vegetation in accordance with the manufacturer's recommendations for perennial vegetation control, instead of excavating the planting bed.

A minimum of fourteen (14) days post application, or when the perennial species shows the visible effects of the treatment, the Contractor shall mow, at no expense to the State, all treated bed areas to a maximum height of 4 inches (100 millimeters).

Plant pits may then be excavated, and the excavated soil and vegetative debris shall then be immediately removed from the project site.

In planting bed areas following the excavation of the pits, but before the installation of plant material, the remaining turf grasses and unwanted vegetation shall be sprayed, unless otherwise directed by the Engineer, with Glyphosate at the manufacturer's recommended rate.

5. Pits: The pit diameters shall be twice the diameter of the root-spread or container diameters, and shall be 2- inches (50 millimeters) less than the height of the rootball measured from the bottom of the ball to the root collar. (i. e. A 12-inch (300 millimeters) measurement between the root collar and the bottom of the rootball will require a 10-inch (250 millimeters) deep pit). Any excavation in excess of that required shall be replaced with planting soil and compacted to the satisfaction of the Engineer.

6. Obstructions Below Ground: Any rock or underground obstruction shall be removed to the depth necessary for planting as specified, unless other locations for the planting are approved by the Engineer. If removal of obstructions results in a deeper hole than needed for planting, backfill material shall be added and compacted to the satisfaction of the Engineer.

7. Backfill: Backfill shall conform to M.13.01-1 Planting Soil.

8. Setting Plants: All plants shall be plumb and at a level that is 2-inches (50 millimeters) higher than the surrounding ground. Backfill material for all plants shall be thoroughly and properly settled by firming or tamping. Thorough watering shall accompany backfilling. Saucers capable of holding water shall be formed at individual plants (exclusive of plant beds) by placing ridges of planting soil around each, or as directed by the Engineer.

a. Balled and Burlapped plants: Plants shall be handled in such manner so that the soil will not be loosened from the roots inside of the ball. Carefully place the plant into the prepared pits and backfill with planting soil to one - half the depth of the pit, thoroughly tamp to the satisfaction of the Engineer around the ball. Fill the remaining area of the pit with water. Once water has completely drained, loosen the bur-

lap and peel down the top one third. If wire baskets are used, cut and bend down the top third of the basket.

Roots that have been wrapped around the ball within the burlap shall be straightened and the remainder of the pit filled with planting soil tamped to ensure that no air pockets remain.

b. Container Grown Plants: Carefully remove the plant from the container over the prepared pits. Gently loosen the soil and straighten all roots as naturally as possible. Place into the bottom of the pit. Backfill with planting soil to one - half the depth of the pit. Thoroughly tamp to the satisfaction of the Engineer.

Fill remaining area of the pit with water. Once water has completely drained fill the remainder of the pit with planting soil tamped to ensure that no air pockets remain.

c. Bare-roots Plants: Carefully spread roots as naturally as possible and place into the bottom of the pit. All broken or frayed roots shall be cleanly cut off. Backfill with planting soil to one - half the depth of the pit. Thoroughly tamp to the satisfaction of the Engineer. Fill remaining area of the pit with water. Once water has completely drained fill the remainder of the pit with planting soil tamped to ensure that no air pockets remain.

9. Fertilizing: Shrub beds shall be fertilized at the rate of 3 pounds per 100 square feet (1.3 kilograms per 9 square meters) of surface area (broadcast). The fertilizer shall be uniformly applied to the surface of the beds and worked into the upper 2 inches (50 millimeters) of soil. Individual trees shall be fertilized at the rate of 2 pounds per inch (1 kilogram per 25 millimeters) of trunk diameter, and the fertilizer shall be mixed into the upper 2 inches (50 millimeters) of soil.

A second application of fertilizer shall be applied to all plants at the same specified rates over the woodchip mulch at the end of the period of establishment.

10. Watering: All plants shall be watered upon setting and as many times thereafter as conditions warrant.

The following is a guide for minimum requirements:

<u>Trees</u>:

2 ½” Caliper and less – Fifteen (15) gallons each.
3” to 5” Caliper – Twenty (20) gallon each.
5 ½” Caliper and above – Twenty-five (25) gallon each.

<u>Shrubs</u>:

24” and less – Six (6) gallon each.
More than 24”- Ten (10) gallon each.
Vines, Perennials, and Ornamental Grasses – Three (3) gallons each.

Groundcovers and Bulbs – Two (2) gallons per square foot.

Water shall be applied at a controlled rate and in such a manner to ensure that the water reaches the root zone (saucer) of the plant or plant bed and does not run off to adjacent areas. Watering shall be applied in a manner that does not dislodge plants, erode soil or mulch, or cause damage to saucer.

The Contractor may use slow-release, drip irrigation bags for watering in accordance with manufacturer's instructions. The use of these portable/temporary irrigation bags will require the approval of the Engineer. Overhead hydro-seeder spray nozzles shall not be used as watering devices.

11. Guying and Staking: Immediately after planting, trees shall be guyed or staked as shown on the planting detail sheet of the plans, or as directed by the Engineer. Guy wires, hose and tree support stakes shall be removed after the initial establishment period.

12. Wrapping: Wrapping shall be placed around all trunks of deciduous trees 2 inches (50 millimeters)

or more in caliper or as directed by the Engineer. The wrapping shall start at the base of trees, shall cover the entire trunk surfaces, and shall terminate at the first branches. The wrapping shall be tied at top, bottom, and at intervals of not more than 2 feet (600 millimeters). Wrapping shall be done at the time of planting but not before inspection of the plant.

13. Pruning: As directed by the Engineer, plants shall be pruned at the project site before or immediately after planting in accordance with the best horticultural practice. No leader shall be cut unless directed by the Engineer. Broken, or badly bruised branches, sucker growth, etc., shall be removed with clean cuts.

14. Spraying: Spraying with antidesiccant shall be at the Contractor's discretion and as approved by the Engineer at no additional cost to the State.

15. Mulching: Following the plant material installations woodchip mulch (or gravel mulch when specifically called for on the plans) shall be hand placed and spread to a depth of 4 inches (100 millimeters) and raked to an even surface over all saucer areas for individual trees and shrubs and over the entire area of shrub beds and elsewhere as directed.

16. Repair: Repair of existing grass areas damaged by the Contractor in the progress of his work shall be the responsibility of the Contractor, who shall restore the disturbed areas to their original condition at no additional expense to the State.

17. Establishment Period: All plant material shall be subject to a One-Year Establishment Period.

During this time, the Contractor shall use currently accepted horticultural practices to keep all plant material installed in a healthy, vigorous growing condition at the date of final acceptance. The date of final acceptance shall be one full calendar year following the satisfactory completion of the planting activities as confirmed by the Engineer.

An inspection will be held one year from the date of installation with the Contractor, Engineer, and Landscape Designer to determine the acceptability of the plant establishment. An inventory of losses and rejected materials will be made and corrective and necessary clean up measures will be determined at the plant inspection.

SECTION 9.50 TURF ESTABLISHMENT

9.50.01—Description:

The work included in this item shall consist of providing an accepted stand of grass by furnishing and placing seed as shown on the plans or as directed by the Engineer.

9.50.02—Materials:

The materials for this work shall conform to the requirements of Section M.13. The following turf seed mix shall be used:

1. Turf Seed Mix:

In order to preserve and enhance the diversity, the source for seed mixtures shall be locally obtained within the Northeast USA including New England, New York, Pennsylvania, New Jersey, Delaware, or Maryland. One approved seed mixture is detailed below. Other proposed mixtures must be approved by the Conn DOT Landscape Design office.

Proportion (Percent)	Species Common name	Scientific name
20	Abbey Kentucky Bluegrass	Poa pratensis
10	Envicta Kentucky Bluegrass	Poa pratensis
25	Pennlawn Red Fescue	Festuca rubra
15	Ambrose Chewing Fescue	Festuca rubra
30	Manhattan Ryegrass	Lolium perenne

9.50.03—Construction Methods:

Construction Methods shall be those established as agronomically acceptable and feasible and that are approved by the Engineer. Rate of application shall be field determined in Pure Live Seed (PLS) based on the minimum purity and minimum germination of the seed obtained. Calculate the PLS for each seed species in the mix. Adjust the seeding rate for the above composite mix, based on 250 lbs. (274 kg.) per acre (hectare).

1. Preparation of the Seedbed:

(a) Level areas and lawns: These areas shall be made friable and receptive for seeding by disking or by other approved methods to the satisfaction of the Engineer. In all cases the final prepared and seeded soil surface shall meet the lines and grades for such surface as shown in the plans, or as directed by the Engineer.

(b) Slope and Embankment Areas: These areas shall be made friable and receptive to seeding by approved methods which will not disrupt the line and grade of the slope surface. In no event will seeding be permitted on hard or crusted soil surface.

(c) All areas to be seeded shall be reasonably free from weeds taller than 3 inches (75 millimeters).

Removal of weed growth from the slope areas shall be by approved methods, including hand-mowing, which do not rut or scar the slope surface, or cause excessive disruption of the slope line or grade. Seeding on level areas shall not be permitted until substantially all weed growth is removed. Seeding on slope

areas shall not be permitted without removal or cutting of weed growth except by written permission of the Engineer.

2. Seeding Season: The calendar dates for seeding shall be:

Spring—March 15 to June 15

Fall—August 15 to October 15

All disturbed soil areas shall be treated during the seeding seasons as follows:

(a) Areas at final grade: Seeding will be accomplished.

(b) "Out-of-season" seedings shall be performed in the same manner as "in-season" seedings. Since acceptable turf establishment is less likely, the Contractor shall be responsible for "in-season" reseeding until the turf stand conforms to Article 300000-9.50.03-5.

(c) During "out-of-season" periods unseeded areas shall be treated in accordance with Section 300000-2.10, Water Pollution Control.

3. Seeding Methods: The grass seed mixture conforming to Article M.13.04 shall be applied by any agronomically acceptable procedure. The rate of application shall be no less than 175 pounds per acre (195 kg/hectare).

Fertilizer conforming to M.13.03 shall be initially applied at a rate of 320 pounds per acre (360 kilograms/hectare) during or preceding seeding. When wood fiber mulch is used, it shall be applied in a water slurry at a rate of 2,000 pounds per acre (2250 kilograms/hectare) with or immediately after the application of seed, fertilizer and limestone. When the grass seeding growth has attained a height of 6 inches (150 millimeters), the specified areas designated herein shall be mowed to a height of 3 inches (75 millimeters). Following mowing, all seeding grass areas (mowed and un-mowed) shall receive a uniform application of fertilizer hydraulically placed at the rate of 320 pounds per acre (360 kilograms/hectare).

4. Compaction: The Contractor shall keep all equipment and vehicular and pedestrian traffic off areas that have been seeded to prevent excessive compaction and damage to young plants. Where such compaction has occurred, the Contractor shall rework the soil to make a suitable seedbed; then re-seed and mulch such areas with the full amounts of the specified materials, at no extra expense to the State.

5. Stand of Perennial Turf Grasses: The Contractor shall provide and maintain a uniform stand of established turf grass species having attained a height of 6 inches (150 millimeters) consisting of no less than 100 plants per square foot (1100 plants per square meter) throughout the seeded areas until the entire project has been accepted.

6. Establishment: The Contractor shall keep all seeded areas free from weeds and debris, such as stones, cables, baling wire, and he shall mow at his own expense, on a one-time-only basis, all slopes 4:1 or less (flatter) and level turf established (seeded) areas to a height of 3 inches (75 millimeters) when the grass growth attains a height of 6 inches (150 millimeters).

Clean-up shall include, but not be limited to, the removal of all debris from the turf establishment operations on the shoulders, pavement, and/or elsewhere on adjacent properties publicly and privately owned.

7. Erosion Control Matting: Erosion control matting shall be installed following seeding where called for on the plans or as directed by the Engineer. Staples shall be installed as per Manufacturer's recommendations. Where two lengths of matting are joined, the end of the up-grade strip shall overlap the down-grade strip.

The Contractor shall maintain and protect the areas with erosion control matting until such time as the turf grass is established. The Contractor shall replace or repair at his own expense any and all erosion control matting areas damaged by fire, water or other causes including the operation of construction equipment.

No mowing will be required in the locations where erosion control matting is installed.

SECTION 9.52 CONTROL AND REMOVAL OF INVASIVE VEGETATION

9.52.01 – Description:

This work shall include all materials, labor and equipment necessary for the identification, eradication, removal, and disposal of unwanted vegetation in locations either indicated on the plan sheets or as directed by an Environmental Scientist from the Connecticut Department of Transportation's Office of Environmental Planning (OEP). While any and all invasive species, including those listed on the website for the Connecticut Invasive Plant Working Group's (CIPWG) Invasive Plants Council (http://www.hort.uconn.edu/cipwg/IPC.html), may be subject to eradication at the direction of the Environmental Scientist, the following species must always be eradicated: tree-of-heaven (*Ailanthus altissima*), Russian and autumn olive (*Elaeagnus angustifolia and E. umbellata*), smooth buckthorn *(Rhamnus cathartica)* and glossy buckthorn (*Frangula alnus*), multiflora rose (*Rosa multiflora*), Japanese barberry (*Berberis thunbergii*), winged euonymus (*Euonymus alata*), shrub honeysuckles (*Lonicera maackii, L. morrowii, L. tartarica,L. X bella, L. xylosteum*), privet (*Ligustrum obtusifolium, L. ovalifolium, L. sinense, L. vulgare*), Oriental bittersweet (*Celastrus orbiculatus*), Japanese knotweed (*Polygonum cuspidatum*), common reed *(Phragmites australis)*, and reed canary grass (*Phalaris arundinacea*). If project-specific invasive species additional to those listed above need to be removed, the Environmental Scientist will give appropriate direction.

All vegetation designated for removal shall be eradicated in its entirety in accordance with the methods submitted by the Contractor and approved by the Environmental Scientist. Some work will be completed within areas where desirable species are present and will remain. The Contractor will be responsible for protection of desirable species that are to remain.

9.52.02 – Materials:

Mechanical removal shall consist of either manual labor, utilizing a weed wrench or other approved machine, or some other approved method that will enable removal of all root pieces and other parts of the target species while minimizing soil disturbance and avoiding any spread of invasive plant material. Where large infestations of invasive/unwanted vegetation are present and identified on the plans, removal via over-excavation of such vegetation and the underlying soils may be required

All herbicides shall be registered for the species being treated and shall be formulated as applicable for target-species foliar treatment, cut surface, or injection applications. Where work in or immediately adjacent to wetlands is necessary, the product label(s) for any chemical/adjuvant formulation applied must indicate that the formulation is approved for aquatic environments.

9.52.03 – Construction Methods:

The Contractor shall have sole responsibility for identifying all invasive species present within the invasive removal areas called out in the contract documents prior to the Pre-Construction Meeting. The Contractor shall submit the required invasive removal plan at the Pre-Construction Meeting for the review and approval of the Environmental Scientist. This plan shall include a list of all invasive species present on site, along with a schedule of operations and an outline of construction methodologies for the required control and removal of invasive vegetation specific to each species listed.

While the Environmental Scientist will review the Contractor's delineation and removal plan, the Contractor must be competent to identify invasive vegetation at all times of the year and to prepare a plan for its eradication without assistance.

During the Pre-Construction Meeting, a field review shall be scheduled so that the Contractor and the Environmental Scientist can review the areas of invasive species removal, the specific species required to be removed, and the Contractor's submitted invasive species control plan. At this time, the Environmental Scientist may designate areas for removal that are additional to those shown on the plans. If changes are required to the originally submitted plan, these changes must be submitted to the Environmental Scientist at least 10 days prior to beginning work.

Upon receiving a Notice to Proceed, the Contractor will delineate all areas designated for invasive species removal. The Contractor will be responsible for maintaining this delineation throughout the life of the contract.

The Contractor will not be allowed to begin construction activities in the designated removal areas until all schedules, outlines, and methodologies are approved in writing by the Environmental Scientist. This schedule must take into consideration the time period required between herbicide application and the physical removal of the target species wherever such removal is to occur. No removal work can occur for a minimum of two weeks after herbicide application. In all cases, the submitted schedule shall consider mechanical methods for removal before proposing herbicide application.

The schedule and outline shall include:

1) The type(s) of invasive species identified in the designated area(s);

2) Species specific treatment methods describing a full course of treatment for each species to achieve eradication. These methods must show:

    a. Removal methods planned (e.g. pulling, cutting, spraying, etc);
    b. Types and concentrations of any herbicides to be used, including any adjuvants; and
    c. Schedules showing dates and types of initial, intermediate and final treatments;

3) Any construction activities planned in designated removal area(s) during the eradication period;

4) Disposal methods, including:

    a. Onsite methods and locations; and
    b. Requests for off-site disposal locations;

5) Proof of DEP licensure for herbicide application;

6) A description of safety equipment required; and

7) Procedures for handling chemical spills.

The Contractor shall also:

a. Maintain the labels for herbicides being used in his/her possession;
b. Provide OEP with a 10 day work notice prior to proceeding so that the Environmental Scientist can schedule to be present when appropriate;
c. Conduct all herbicide formulations and applications, including the addition of appropriate surfactants and other adjuvants, in strict conformance with the manufacturer's recommendation and per requirements of regulatory agencies; and

d. Maintain a written record of herbicide application, including the formulation, concentration, area treated, and date for each application, to be provided by the commercial applicator and submitted to the Environmental Scientist following each treatment.

A “treatment period” for each designated area will be derived from the schedule submitted by the Contractor and determined by the following:

1) The first treatment date of the earliest treatable vegetation; and

2) The last treatment date of the latest treatable vegetation

It is anticipated that many species will require more than one season to obtain complete eradication. The treatment period must take into consideration those species that will require follow up treatments and more than one season for complete eradication. Upon completion of the treatment period, the Contractor shall notify the Environmental Scientist in writing of the status of eradication. If the eradication has not been successful, the Contractor shall also submit additional treatment plans. If the Contractor believes that eradication has been achieved, the Contractor shall request a site inspection by the Environmental Scientist for concurrence. If the Environmental Scientist concurs that eradication has been achieved, the area will be subject to a one (1) year warranty starting on the first day following the inspection by the Environmental Scientist. During this period the Contractor will be responsible for any further occurrences of the invasive species inside the delineated area.

The Contractor will be responsible for removal and eradication of all plant material deemed as invasive or unwanted within the delineated area(s) for the duration of the project or until relieved of responsibility of the removal item, and the delineation shall remain in place until this time.

Flush cut brush and trees shall not be more than 2 inches (50mm) above the ground line. Flush cutting shall be performed in a controlled manner that will prevent the spread of parts or seeds of invasive species. Brush hogging or any other clearing method that may promote the spread of invasive plant material is also not permissible.

Broadcast or uncontrolled spray application will not be permitted, and care must be taken to avoid contacting non-target species and/or deterring the recolonization of native species following application.

Remove all twining vines in treetops to the greatest extent possible without damaging the branches of the supporting desired vegetation. Cut and remove vines overtopping tree canopies. Climbing spikes will not be permitted for aerial work.

Prune out any branches on non-treatment plants that are damaged during removal of vegetation. All corrective pruning shall conform to the ANSI A300 Tree Pruning Standards.

The site must be monitored by the Contractor and any new or regrowth treated prior to beginning installation of any landscape plantings.

Processing and disposal of unwanted vegetation shall be done in a controlled manner so as not to spread invasive seed or plant parts within the surrounding areas. All cut invasive vegetation shall be separated from clearing and grubbing operations and all other cleared material. Invasive plant materials may be buried on site within the Department ROW provided that they are under a minimum of 10 feet (3.0 m) of cover on all sides for Japanese knotweed and phragmites and 3 feet (1 m) of cover on all sides for all other species and/or removed from the site and disposed of at the approved location(s) identified in the Contractor’s submitted schedule and outline of construction methodologies.

No equipment or vehicles other than that required to complete the work will be permitted in the areas designated for invasive vegetation removal. Any equipment used to process invasive materials, such as chippers and transport vehicles, must be cleaned prior to further use. Processing equipment must also be cleaned prior to further transport.

Wherever removal operations result in exposed soils, disturbed areas must be vegetatively stabilized with the appropriate seed mix and protected with hay, cellulous fiber mulch, or erosion control matting. The application rate for hay mulch and fiber mulch shall be 3500 lbs per acre (3920 kg/hectare).

SECTION 9.54 – CONSERVATION SEEDING FOR SLOPES

9.54.01 - Description:

The work included in this item shall consist of providing an accepted stand of established conservation grasses by furnishing and placing seed as shown on the environmental permit plates, construction plans, or as directed by an Environmental Scientist from the Connecticut Department of Transportation's Office of Environmental Planning (OEP) within the wetland creation areas, habitat enhancement areas, and/or designated environmentally sensitive areas. Seeding shall be applied to all constructed slopes associated with the created wetlands, and/or specific areas designated by OEP.

9.54.02 - Materials:

All approved seed mixtures shall be obtained in sufficient quantities to meet the pure live seed (PLS) application rates as required by the seed analysis of the mixture.

The Contractor shall submit the Form for Affidavit-Seed (Official Stationery of Supplier) for the proposed seed mix to the Engineer a minimum of 10-days prior to the seeding date for the area(s) in order to verify that the seed mix is compliant with the specification. The seed mixture shall be delivered to the project in sealed containers/bags and inspected by the Engineer prior to seeding the specified site. Application of fertilizer, where necessary, will be directed by the Environmental Scientist based on a soil analysis of the area to be seeded. The following mix shall be used for this item.

Conservation Mix (for slopes):

In order to preserve and enhance the diversity of native species, it is necessary that the source for seed mixtures used in created wetlands and/or designated environmentally sensitive areas be locally obtained within the Northeast USA including New England, New York, Pennsylvania, New Jersey, Delaware, or Maryland. One approved seed mixture is detailed. Other proposed mixtures must be submitted to OEP and approved by the Environmental Scientist prior to use. The materials certification for any proposed mixture that is different from that described below must be submitted a minimum of ten (10) days prior to delivery on site. This certification must match both the previously approved substitute mixture and the seed tags on the bags that are to be removed upon delivery. No seeding shall occur if all three items do not match.

Pounds (lbs) of PLS per acre	**Scientific Name**	**Common Name**
30	*Festuca rubra*	Creeping red fescue
20	*Lolium multiflorum*	Annual rye-grass
15	*Panicum clandestinum*	Deer tongue
10	*Chamaecrista fasciculata*	Partridge pea
15	*Schizachyrium scoparium*	Little bluestem
10	*Tridens flavus* var. *flavus*	Purple top

9.54.03 – Construction Methods:

Construction Methods shall be those established as agronomically acceptable and feasible as determined by the OEP. Rate of application shall be 100 lbs PLS per acre. Where seed is not obtained based on PLS quantities, the actual application rate of approved and delivered seed mixture will be determined by calculating the amount of PLS from the information provided on the seed tags at delivery. The PLS formula will be used to determine the desired application rate to obtain a stand of even seed growth for

each seed type to be applied within the seeded area(s). The rate of application will be increased based on the actual percentage of PLS for each species delivered to the site so that each species is seeded at 100 % PLS. The PLS formula is as follows:

(Germination Percentage X Purity Percentage) / 100 = Percentage PLS

The Engineer shall determine and verify the actual application rate based on the PLS formula for the areas to be seeded with conservation mix.

The seed shall be temporarily stabilized with hay or cellulous fiber mulch. The application rate for hay mulch and fiber mulch shall be 3500 lbs per acre. Unless directed by OEP, absolutely no mowing shall be conducted within the areas that are seeded with conservation mix.

All areas to receive conservation seed mix shall be seeded during the spring, fall, or as directed by the OEP. Spring seeding must be performed between March 15th and June 15th. Fall seeding must be performed between August 15th and October 15th. At the direction of the Environmental Scientist, partial seeding of a site may be required in order to stabilize slopes that are finished prior to completion of the entire creation site.

SECTION 12.09 PAINTED PAVEMENT MARKINGS

12.09.01—Description:

Work shall consist of furnishing and installing painted pavement markings, hot applied painted pavement markings and painted legend, arrows and markings, of the type and color specified at the locations indicated on the plans and in conformity with the plans, these specifications, and as directed by the Engineer.

Painted legend, arrows, and markings includes paint installed with a hand striping machine such as: stop bars, crosswalks, parking stalls, lane arrows, legends, markings within gore areas, and painting of paved islands or medians.

Painted pavement markings and hot applied painted pavement markings include paint installed with a truck-mounted painting machine such as center lines, lane lines and shoulder lines.

The exact location for passing zones will be determined by the Engineer prior to the application of the pavement markings. The Engineer shall be notified a minimum of two weeks before the anticipated date of painting, to allow time for the determination of the passing zone locations.

12.09.02—Materials:

Materials for this work shall conform to the requirements of Article M.07.20 for waterborne pavement marking paint, Article M.07.21 for hot-applied waterborne pavement marking paint and Article M.07.30 for glass beads.

12.09.03—Construction Methods:

Pavement areas to be painted shall be dry and sufficiently cleaned of sand and road debris so as to provide an acceptable bond between the paint and the pavement.

Paint shall be applied at a rate of 100 to 115 square feet per gallon (2.5 to 2.8 square meters per liter), with glass beads applied at a rate of 6 pounds per gallon (0.72 kilograms per liter) of paint for painted pavement markings and painted legend, arrows, and markings, and 8 pounds per gallon (0.96 kilograms per liter) of paint for hot-applied painted pavement markings.

Hot-applied paint shall be applied at a temperature of 130°F to 145°F (54°C to 63°C) at the spray gun.

All painting shall be performed in a neat and workmanlike manner. The lines shall be sharp and clear with no feathered edging or fogging and precautions shall be taken to prevent tracking by tires of the striping equipment. Paint shall be applied parallel to the centerline or as shown on the plans with no unsightly deviations.

After application, the paint shall be protected from crossing vehicles for a time at least equivalent to the drying time of the paint.

END OF SECTION 300000

SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division –1 Specifications, apply to work specified in this section.

1.2 SUMMARY

A. Dewatering consists of performing work necessary to keep the work free from ground and/or surface water for the duration of the project, remove surface water and/or control the groundwater levels and hydrostatic pressures in order to permit excavation and construction under this Contract to be performed in the dry. The control of surface and sub-surface water and ice and snow are part of dewatering requirements.

B. Dewatering shall comply with the approved "Stormwater Pollution Control Plan" and requirements of Section 1.10 and as follows.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with water disposal requirements of authorities having jurisdiction.

B. Operator Qualifications: Perform dewatering with supervisory personnel that have at least 5 years experience in field of dewatering.

PART 2 - PRODUCTS

2.1 Provide pumps, environmental controls (including but not limited to filter bags), temporary structures and facilities, and all other materials and equipment to adequately maintain the site free from ground and/or surface water. Pumps shall be of adequate capacity to dewater excavations, as well as, basements, tunnels, and other structures as required for the performance of work.

PART 3 - EXECUTION

3.1 GENERAL

A. Pumped water must be discharged in accordance with the requirements of Section 1.10.03, Water Pollution Control. Submit a dewatering plan to the Engineer for approval prior to the start of construction activities requiring dewatering.

B. Temporary diversions, barriers, as well as, temporary structures and facilities shall be designed and installed as required.

C. Unless otherwise provided, or directed, all temporary structures and facilities shall be removed and disposed of in an approved manner when no longer required.

D. The Contractor shall be responsible for performing and scheduling work under this item so as not to interfere with any sequence of operations developed for this project. Delays as a result of work required under this item shall not constitute a claim for an extension of contract time.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
   1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
   2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Engineer and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

3.3 INSTALLATION

A. Installation, operation, maintenance, supervision, supply, dismantling, and removal from the site of the dewatering equipment.

B. The Contractor must familiarize himself with the potential for excessive rainfall, the site conditions, the ground conditions, and the groundwater conditions. Copies of the logs of soil borings and information on the ground-available data are furnished for the convenience of the Contractor in interpreting underground conditions.

C. Drainage of the Site - The Contractor shall maintain and operate adequate surface and subsurface drainage methods to the satisfaction of the Engineer in order to keep the construction site dry and in such condition that placement and compaction of fill may proceed unhindered by saturation of the area. During construction, the surface of the backfill area shall be left in such condition that precipitation and/or surface water will run off without ponding.

D. It is anticipated that some deeper excavated areas will encounter the ground water table. Where excavation encounters the ground water table, the Contractor must lower the ground water table prior to excavating, a minimum of 2 feet below the final subgrade using a method approved by the Engineer. The Contractor must submit to the Engineer and Soils Engineer his proposed dewatering method for approval prior to performing any dewatering work.

E. Maintain adequate control so that the stability of excavated and construction slopes is not adversely affected by water, that erosion of soil fines is controlled, and the flooding of excavations or damage to adjacent structures and their foundations does not occur. Drain surface water away from the excavation.

F. Provide an adequate system to lower and control groundwater in order to permit excavation, construction of structures, and placement of fill materials under dry conditions. Install sufficient dewatering equipment to pre-drain water-bearing strata above and below bottom of structure foundations, drains, sewers, and other excavations.

G. Dewatering system shall be so designed as to prevent removal of soil fines from the site during the dewatering operation.

H. Reduce hydrostatic head in water-bearing strata below structure foundations, drains, sewers, and other excavations to the extent that water level and piezometric water levels in construction areas are below prevailing excavation surface.

I. Prior to excavation below groundwater level, place system into operation to lower water levels as required and then operate it continuously 24 hours a day, 7 days a week until drains, sewers and

structures have been constructed, including placement of fill materials, and until dewatering is no longer required.

J. Provide standby equipment on site, installed and available for immediate operation if required to maintain dewatering on a continuous basis in event any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, perform work as may be required to restore damaged structures and foundation soils at no additional expense.

K. The construction sequence shall be performed to minimize the amount of groundwater removed from the excavation. The bottom of the excavation shall be in a suitable condition to the extent required to maintain the subgrade free of standing water and in a stable condition.

L. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

M. Upon work completion, remove from site, tools, materials, and rubbish of every sort, created by work of this section. Leave premises neat and orderly.

END OF SECTION 312319

SECTION 312500 – TEMPORARY EROSIONS AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division –1 Specifications, apply to work specified in this section.

1.2 DESCRIPTION

A. This item shall consist of temporary erosion control measures as shown on the approved Erosion Sedimentation Control Plan or as directed by the Engineer for the life of the contract to control water pollution, soil erosion, and siltation.

B. The temporary erosion control measures contained herein and as shown on the contract drawings shall be installed and coordinated to assure economical, effective, and continuous erosion control throughout the construction period.

C. The Contractor shall install and maintain the devices during construction. Maintenance shall be performed as required and/or as directed by the Engineer. At a minimum, maintenance shall be performed once per week or after storm events of 0.5 inches or greater. Contractor shall have a log of the erosion control inspections and forward the reports of such inspections to the Engineer on a weekly basis. Failure of the Contractor to undertake daily erosion control inspections or to forward the reports to the Engineer shall subject the Contractor to delays in processing of pay requisitions.

1.3 RELATED WORK

A. Section 300000 – Form 816 Site Work.

B. Division 01, High Performance Buildings Requirements Section 018113.13 for credit 16a-38k-3(h).
   1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Anti-Tracking Pad: Materials for this work shall conform to the requirements of the Standard Specifications Article M.01, Size No. 3 Stone. Geotextile shall conform to the Standard Specifications Article M.08.01-26 (to be on approved Connecticut Department of Transportation list). The Contractor shall provide samples and source of all materials.

B. Geotextile Sack: Geotextile sack shall be manufactured from a specially designed woven polypropylene geotextile sewn by a double needle machine, using a high strength nylon thread. Sack shall be manufactured by one of the following:

1. Siltsack
   Geo-Synthetics, LLC
   www.geo-synthetics.com
   (800) 444-5523

2. Dandy Sack
   Dandy Products Inc.
   www.dandyproducts.com
   (800) 591-2284

3. FLeXstorm Inlet Filters
   Inlet & Pipe Protection
   www.inletfilters.com/ (866) 287-8655

The sack will be manufactured to fit the opening of the catch basin or drop inlet. Sack will have the following features: two dump straps attached at the bottom to facilitate emptying of the sack and lifting loops as an integral part of the system to be used to lift the sack from the basin. The sack shall have a restraint cord approximately halfway up the sack to keep the sides away from the catch basin walls. This cord is also a visual means of indicating when the sack should be emptied. Once the strap is covered with sediment, the sack should be emptied, cleaned and placed back into the basin.

C. Siltation Fence: Synthetic filter fabric shall be a pervious sheet of polypropylene, nylon, polyester or polyethylene yard conforming to the requirements in Table below.

Physical Property	Requirements
Filtering Efficiency Tensile Strength at 20% (max.) Elongation Slurry Flow Rate	75% -80% (min.) Standard Strength -30 lb/linear inch (min.) Extra Strength -50 lb/linear inch (min.) 0.3 gal/ft 5/min (min.)

1. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature range of 0 to 120 degrees F.
2. The filter fabric shall be purchased in a continuous roll to avoid joints and shall be furnished with suitable wrapping for protection against moisture and extended ultraviolet exposure prior to placement.
3. Siltation fence shall be stored in a manner that will protect it from the elements. If stored outdoors, it shall be elevated and protected with a waterproof cover. Both the geotextile and threads associated with the fence shall be resistant to chemical attack, mildew, and rot. Each roll of fabric shall be labeled or tagged to provide product identification as well as inventory and quality control purposes.

D. Erosion Control Logs: Erosion control logs shall be used where excavations cross existing pavements, where applicable as a substitute for siltation fence, or as directed by the Engineer.

E. Hay Bales: Refer to Section 300000-2.18

PART 3 - EXECUTION

3.1 EXECUTION

A. General:

1. The Owner has secured the required NPDES Permit, including approval of the Erosion and Sedimentation Control Plans. The Contractor is responsible for fully complying with all approval conditions and regulatory requirements that may be established within approvals/permits. Where permit conditions or approvals refer to actions by the Owner/Permittee, it is clearly understood to be a condition placed upon the Contractor and an action solely required to be performed by the Contractor.
2. The Contractor is solely responsible for the Preparation, Submission and Securing of Amendments to the acquired approvals, if needed, because of his/her specific means and methods used for the performance of the work.
3. The Contractor shall conduct operations to comply with the approved Erosion and Sedimentation Control Plan. If the approved plan(s) cannot be followed, the Contractor shall obtain written approval of Alternative Erosion and Sedimentation Controls by the appropriate regulatory agency. At no time shall water containing sediments or pollutants be discharged into drainage ditches, stormwater pipes or watercourses. In preparing for and setting up the work areas, follow the requirements regarding Borrow, Waste and Staging Areas. Separate water(s) originating outside of the project (Clean Water) or clean surface runoff from those originating within (Dirty Water). Direct dirty water away from project construction areas and into an appropriate erosion and sedimentation control device.
4. All erosion control measures shall be installed and approved by the Engineer prior to the start of earth disturbance activities.
5. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other Federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.
6. Method of stripping vegetation shall be such as to minimize erosion. Fills shall be placed and compacted in such a manner that soil sliding and erosion is minimized. Grading shall be done in such a manner as not to divert water on to the property adjoining the Airport's right-of-way or construction site. If the Contractor fails to employ adequate and acceptable erosion control techniques during construction, the Engineer may order a suspension of the work until implementation of satisfactory techniques are agreed upon and demonstrated, and the Contractor shall have no claim for damages or time extension resulting from such delays.
7. As directed by the Engineer, the Contractor shall limit the surface area of erodible earth material exposed by clearing and/or provide immediate temporary pollution control measures to minimize contamination of adjacent swales or other watercourses, or other areas of water impoundment. Temporary erosion control measures may be required to correct conditions that develop during construction that were not foreseen during the design stage; or that are needed temporarily to control erosion that develops during normal construction practices.
8. The erosion control features installed by the Contractor shall be acceptably maintained by the Contractor during the construction period. The Contractor shall promptly repair or replace barriers that are ineffective or where deficiencies exist, and if necessary, install additional barriers. The Contractor shall inspect all barriers immediately after each rainfall and at least once each day.

9. Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into or near wetlands, swales, and impoundments or into natural or manmade channels leading thereto.
10. In the event of a significant rainfall event, extra erosion control measures shall be taken, such as the use of hay bales or silt fence.
11. All areas where temporary erosion controls are installed must be repaired and restored to their original condition until project completion or as directed by the Engineer. Also, all other areas disturbed or affected by construction shall be restored to their original condition.

B. Anti-Tracking Pad
1. Work shall consist of an anti-tracking pad constructed at points of vehicular ingress and egress on the construction site at the locations shown on the Plans or as directed by the Engineer. Anti-Tracking Pads shall be constructed to the dimensions and details shown on the plans and in accordance with these specifications.
2. Construction: The area of the construction entrance shall be cleared of all vegetation, roots and other organic or unsuitable material. The subgrade in the area of the pad shall be graded to drain and the area shall be covered with geotextile fabric. The pad of stone, to the thickness shown on the plans, shall be placed on the geotextile. The pad shall have a minimum width and a minimum length as shown on the plans.
3. Maintenance: The anti-tracking pad shall be maintained in a condition that will prevent tracking or flowing of sediment onto public rights-of-way. Stone shall be added, dressed and cleaned as required. All sediment spilled, dropped, washed or tracked onto public rights-of-way shall be removed immediately.
4. Removal: When the construction entrance is no longer needed, or upon project completion, the anti-tracking pad shall be removed in its entirety and the area shall be restored as directed. The pad materials and sediments shall be removed to a location approved by the Engineer.

C. Geotextile Sack
1. This work shall consist of furnishing, installing, cleaning, maintaining, replacing, and removing sediment control at catch basins at the locations as shown on the plans and as ordered by the Engineer
2. Installation, removal, and maintenance shall be per manufacturer instructions and recommendations.

D. Siltation Fence
1. The fence shall be staked and entrenched to a minimum depth of six inches below the existing surface. Posts should be 4 feet long and should be composed of 2” x 2” pine (or equivalent).
2. All siltation fence installed shall be removed and disposed of legally off property at project completion or as directed by the Engineer

END OF SECTION 312500

SECTION 313000 – LOW DENSITY FOAM CONCRETE FILL (LDFC)

1. GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The work in this Section includes furnishing and placing all labor, materials, equipment, and supervision for installation of cast-in-place Low Density Foam Concrete (LDFC) as engineered fill at the locations indicated by the Contract Documents.

B. The Certified Supplier-Producer shall provide equipment capable of placing at least 1,500 cu.yds. per day, or more, as required to meet the schedule. The Certified Supplier-Producer and Installer shall provide the means and methods to protect completed work from water and soil contamination due to runoff, erosion, or ponding.

C. Related Sections include the following:

1. Division 1 Section "Special Inspections and Structural Testing" for independent testing agency procedures and administrative requirements.
2. Division 31 Sections for earthwork, site preparation, and foundation drainage requirements.
3. Div. 01, High Performance Buildings Requirements Section 018113.13 for credits 16a-38k-4(d)10:
   1. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and <u>NOTICE TO CONTRACTOR –SUBMITTALS.</u>

B. Product Data: For each type of manufactured material and product indicated.

C. Design Mixes: Submit mix design for Low Density Foam Concrete (LDFC) fill, showing compliance with specified properties. Include all materials to be used and their sources.

D. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

1. Cementitious materials
2. Aggregates
3. Foaming Agent

4. Admixtures

E. Qualifications: Submit resume of LDFC Subcontractor showing specified qualifications. Include qualifications of Subcontractor's superintendent and/or foreman. Submit written evidence of acceptance of the certified producer/supplier by the manufacturer.

F. Equipment: Submit description of equipment and placement methods to verify compliance with specifications.

G. Sequencing Plan: Submit plan indicating the construction sequence for constructing the entire fill section, including piles, walls, utilities, LDFC fill, select backfill, and concrete pavement.

H. Field quality-control test and inspection reports.

I. Minutes of preinstallation conference.

J. At least two (2) weeks prior to placing, submit eight - 3" diameter by 6" high cylinder samples of the specified LDFC fill. The accepted samples shall become the standard of the material furnished under this Contract.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Subcontractor shall have a record of experience and quality of work placing LDFC fill that is satisfactory to the Architect/Engineer, including the following:

1. Shall be capable of developing a mix design, batching, mixing, handling, and placing LDFC fill.
2. Shall be regularly engaged in the production and placement of LDFC for engineered fills.
3. Shall have satisfactorily completed at least three (3) other projects of mass LDFC fills of no less than 5,000 cubic yards in the past two (2) years.
4. Shall be pre-qualified and approved, in writing, by the foam agent manufacturer of the LDFC fill material.
5. The specialized batching, mixing, and placing equipment shall be automated and certified for the purpose by the manufacturer of the LDFC fill material. Cementitious materials and water may be premixed and delivered to the site. Foam agents shall be added and mixed at the site using the aforementioned equipment.
6. Use adequate numbers of skilled workers, including the subcontractor's superintendent and/or foreman, who are thoroughly trained and experienced in the necessary crafts and who are familiar with the specified requirements and the methods needed for proper performance of the Work.

B. The manufacturer's representative shall be experienced in placement of LDFC fill and shall be on-site full-time during placement.

C. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency

laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

E. Reference Publications: Comply with the following, unless more stringent provisions are indicated:

1. ACI 305R, "Hot Weather Concreting."
2. ACI 306R, "Cold Weather Concreting."
3. ACI 523.1R, “Guide for Cast-in-Place Low Density Concrete.”
4. ASTM C138, “Standard Test Method for Unit Weight, Yield, and Air Content of Concrete.”
5. ASTM C150, “Standard Specification for Portland Cement.”
6. ASTM C311, “Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete.”
7. ASTM C494, “Standard Specification for Chemical Admixtures for Concrete.”
8. ASTM C495, “Standard Test Methods for Compressive Strength of Lightweight Insulating Concrete.”
9. ASTM C496, “Standard Test Methods for Splitting Tensile Strength of Cylindrical Concrete Specimens.”
10. ASTM C513, “Standard Test Methods for Securing, Preparing, Obtaining, and Testing Specimens of Hardened Lightweight Insulating Concrete for Compressive Strength.”
11. ASTM C796, “Standard Method of Testing Foaming Agents for Use in Producing Cellular Concrete Using Preformed Foam.”
13. ASTM C869, “Standard Specification for Foaming Agents for Use in Making Preformed Foam for Cellular Concrete.”

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design LDFC mixtures.

G. Preinstallation Conference: Conduct conference at Project site. The Contractor shall record, type, and distribute minutes of the meeting to all parties concerned within 5 days.

1. At least 14 days prior to submitting design mixes, conduct a meeting to review detailed requirements for preparing LDFC design mixes and to determine procedures for satisfactory placement operations. Review requirements for submittals, status of coordinating work, and availability of materials. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications. Require representatives of each entity directly concerned with LDFC fill to attend conference, including, but not limited to, the following:

a. Subcontractor's superintendent.
b. Special Inspector.
c. Independent testing agency responsible for LDFC design mixes.
d. Independent testing agency responsible for field quality control.
e. Ready-mix concrete producer.
f. LDFC certified supplier/producer.
g. LDFC Installer.
h. Architect/Engineer.

2. Review special inspection and testing agency procedures for field quality control, cold- and hot-weather concreting procedures, curing procedures, joints, and protection.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type II.

B. Fly Ash: ASTM C 618, Class C and compatible with foaming agent.

C. Water: Potable and complying with ASTM C 94.

2.2 ADMIXTURES

A. Foaming Agent Admixture: Shall comply with ASTM C869 in accordance with ASTM C796.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. PROVOTON, A. J. Voton, LLC.
   b. Mearl Geofoam Liquid, Mearl Corp.
   c. Rheocell 30, Master Builders, Inc.

B. Admixtures for water reducing, retarding, accelerating, improving the bond, and other specific properties, may be used when specifically designed by the manufacturer of the Low Density Foam Concrete (LDFC) fill.

2.3 PROPORTIONING AND DESIGN OF CONCRETE MIXES

A. It is the intent of this Specification to secure, for every part of the work, LDFC fill of homogeneous structure which, when hardened, will have the required strength, appearance and resistance to weathering.

B. Prepare design mixes for the specified type and strength of LDFC fill indicated by laboratory trial batch methods, which include compressive strength and cast density testing results.

C. Provide Low Density Foam Concrete (LDFC) fill with the following properties:

1. Cast Density: 30 pcf (min.) / 35 pcf (max.)
2. Compressive Strength: 25 psi at 24 hours
3. Compressive Strength: 100 psi at 28 days
4. Compressive Strength: 120 psi at 56 days
5. Modulus of Elasticity: 90 ksi
6. Water absorption: 50 kg/m^2 (total absorption through 1 m^2 of foam concrete during 10 years exposure for a constant head of 1 meter water).
7. Freeze thaw resistance: Minimum of 80% Relative E-modulus at 300 cycles.

D. No LDFC fill may be placed in the work until the Architect/Engineer has approved the appropriate design mix.

E. If, during the progress of the work, any difficulty should occur in securing LDFC fill of the required workability and strength, the Architect/Engineer may order such changes in the proportions or materials, or both, as may be necessary. Any changes so ordered shall be made at the Contractor's expense.

F. Admixtures: Use admixtures according to manufacturer's written instructions.

PART 3 - EXECUTION

3.1 PREPARATION

A. Subgrade Placement: A filter fabric shall be placed directly on the approved subgrade. After the placement of the specified compacted stone drainage layer, a second filter fabric layer shall be placed. Place the LDFC fill material on the upper filter fabric layer on slopes no steeper than 2H:1V.

B. There shall be no standing water in the area to be filled. If necessary, dewatering shall be continuous during the time the LDFC fill is constructed.

C. Any items to be encased in the LDFC fill shall be set in place prior to installation of the LDFC.

D. Do not proceed with LDFC fill placement until unsatisfactory subgrade conditions have been corrected.

3.2 DELIVERY, HANDLING, & STORAGE

A. Protect materials before, during, and after installation. Protect the work and materials of all other trades.

B. Store materials in accordance with ACI 304. Store cement and fly ash in weather-tight bins, silos, or buildings that will exclude moisture and contaminates.

C. Store fluid or dry admixtures to avoid contamination, moisture accumulation, evaporation, damage, and in accordance with manufacturer’s temperature and other recommendations. Protect liquid admixtures from freezing and temperature changes that would adversely affect characteristics, in accordance with manufacturer’s recommendations.

D. Keep packages of material in original containers with seals unbroken and labels intact until time of use.

E. In the event of damage, immediately make replacements and repairs to the acceptance of the Architect/Engineer, at no additional cost to the Owner.

3.3 BATCHING AND MIXING

A. LDFC fill shall be produced utilizing specialized automated proportioning, weighing, mixing, and foam producing equipment, which is capable of meeting the specified properties. Transit mixers will not be acceptable for mixing LDFC fill.

B. Dry materials shall be weighed on a scale that operates within a tolerance of one and one-half percent (1 ½%).

C. Foam generating equipment shall be used to produce a predetermined quantity of pre-formed foam that shall be mixed and blended with the cementitious slurry. Equipment shall be calibrated to produce a precise and predictable volumetric rate of foam with stable, uniform micro-bubbles. Foam may be batched or continuously generated to produce a continuous flow of LDFC fill at the point of placement.

D. Avoid excessive handling of the material. After sufficient mixing of the foam with slurry, LDFC fill shall be conveyed promptly in its final location. Concrete piston pumps shall not be used to place finished foam concrete.

3.4 PLACEMENT

A. Prior to LDFC fill placement:

1. Subgrade areas shall be approved by the Testing Agency.
2. The specified layers of filter fabric and compacted stone drainage layer be installed.
3. Areas to be filled shall not have any standing water in them prior to placement of LDFC. The Subcontractor shall ensure that the LDFC fill remains above the water table at all times during construction
4. Care should be taken to avoid freezing before initial set of LDFC fill.

B. Cast the LDFC fill in lifts not exceeding 24” in a manner to prevent segregation or excessive consolidation.

C. Scarify each lift to a minimum depth of ½” using a hand rake before placing the next lift. Scarifying shall be done after sufficient curing time such that foot traffic will not excessively damage the lift surface (no greater than ¼” indentation).

D. Allow a minimum of 24 hours between subsequent lifts. Prior to verification of the minimum specified compressive strength, additional lifts may be placed after the 24 hour minimum timeframe, at the Subcontractor’s risk. Any material that does not meet the specified 28-day compressive strength and cast density shall be removed and replaced by the Subcontractor at no additional cost.

E. Move discharge hoses sufficiently to insure level filling through the specified area. Uneven filling is not permitted. Hose length shall not exceed 800 feet.

F. Stagger pours such that vertical joints are at least five (5) feet apart.

G. Final surface of foam concrete shall be within ±0.1’ of the plan elevations and slope away from walls and structures at a grade no flatter than 2%.

H. After installing the final layer of material, construction materials and equipment shall not load the LDFC fill until it has attained the minimum specified 28-day compressive strength.

I. Cold-Weather Placement: Comply with ACI 306 and as follows. Protect LDFC work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered LDFC fill mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place LDFC fill on frozen subgrade or on subgrade containing frozen materials.
3. LDFC fill shall not be placed at a temperature of less than 32 deg F, nor when freezing conditions are expected in less than 24 hours unless precautions are taken to maintain temperatures above freezing.
4. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

J. Hot-Weather Placement: Comply with ACI 305 and as follows:

1. Maintain LDFC fill temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.
2. Fog-spray subgrade just before placing LDFC fill. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.5 PROTECTION

A. General: Protect freshly placed LDFC fill from premature drying and excessive cold or hot temperatures. Comply with ACI 306 for cold-weather protection and with recommendations in ACI 305 for hot-weather protection.

B. Protect each lift of LDFC fill from rain during initial cure (a minimum of 8 hours) by application of minimum 4 mil polyethylene plastic sheets or other means. Insulated blankets or other means shall be provided to prevent the LDFC from freezing during low temperature installations. The LDFC Subcontractor shall determine what amount of rain protection is adequate to mitigate problems caused by rain during installation and curing. Rain can cause complete collapse of the material before it sets.

C. The LDFC Subcontractor shall prevent surface water runoff from adjacent slopes causing soil contamination, debris, or ponded water of any lift placed.

3.6 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing agency to perform field tests and inspections and prepare test reports.

B. Inspections: Special Inspections required are enumerated in the Special Inspection Plan.

C. LDFC Subcontractor shall provide a set of six (6) compressive strength and density test cylinders for each 200 cubic yards placed, with a minimum of two (2) sets per day. In addition, the LDFC Subcontractor shall record and measure cast densities at the point of placement hourly. Mix shall be adjusted as required to obtain the specified cast density range at the point of placement.

D. Compressive-Strength and Density Tests: For each set, test one specimen at 24 hours, one at 2 days, one at 7 days, two at 28 days, and one specimen at 56 days.

E. Testing shall be done according to Appendix A: Casting, Curing, Handling, Preparing And Testing of Foam Concrete Specimens.

F. Test results shall be reported in writing to Architect/Engineer, concrete manufacturer, Design/Builder, and Subcontractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, density, compressive breaking strength, and type of break for both 7-and 28-day tests.

G. Throughout the mix design and testing program, pocket penetrometers shall be used to correlate tip resistance with cylinder strengths. These field tools shall be available at all times to index the unconfined compressive strength of the LDFC fill. A penetrometer calibrated with the test cylinders shall be the same instrument used in the field. In general, a soil penetrometer is useful up to 9,000 psf (63 psi) and concrete penetrometers are useful up to 14,000 psf (97 psi). Both penetrometer types shall be calibrated. The use of penetrometers shall not be construed to replace the testing program. It is only an index measurement of LDFC correlated to strength. Note, however, that the choice to use the penetrometers in the field, in advance of test cylinder results, are at the Subcontractor’s risk, and shall not in any way prevent later rejection when defects are discovered, nor shall it obligate the Architect/Engineer for final acceptance.

H. For cylinder strength and density tests in dispute, with sufficient data provided by the Subcontractor’s testing laboratory, the Owner’s testing agency may, at its discretion, accept alternative LDFC fill strength and density testing methods. These may include sample cubes, field penetration / penetrometer testing, or other field and laboratory testing methods supported by ASTM or industry standards. These alternatives shall not relieve the Subcontractor from satisfying the minimum strengths outlined in these specifications. The Subcontractor shall provide access to in-situ LDFC for cut block or cylinder samples, at no additional cost to the Owner. All field samples shall be taken in accordance with ASTM or industry standards and shall match laboratory sample geometry.

I. Additional Tests: Testing and inspecting agency shall order additional tests of LDFC when test results indicate that slump, air entrainment, compressive strengths, density, or other requirements have not been met. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders or by other applicable methods. Additional testing and inspecting, at Subcontractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

J. LDFC fill materials that do not meet specification requirements shall be removed and replaced at no additional cost to the Owner.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

A. Measurement for payment for LDFC fill in place shall be on a lump sum basis in accordance with the Contract Documents.

4.2 PAYMENT

A. Payment for this lump sum project shall be established in the Contract.

END OF SECTION 313000

APPENDIX A
CASTING, CURING, HANDLING, PREPARING AND TESTING OF FOAM CONCRETE SPECIMENS

1.0 Introduction

A. Foam (cellular) concrete is a mixture of cement, fly ash, and water with foaming agent. Low density caused by the presence of microbubble air voids instead of (lightweight) aggregate result in material properties and general behavior that differ from ordinary (lightweight) concrete. Foam concrete samples at an early age are extremely fragile – improper care will result in a loss of quality and a decrease in the unconfined compressive strength results.

B. At the present time, the American Society for Testing and Materials (ASTM) does not designate a standard test method for compressive strength of foam (cellular) concrete for geotechnical applications. This guideline sets forth certain precautions to ensure the integrity of foam concrete testing procedures, and is based on ASTM standards and best practices. Unconfined compressive strength (UCS) testing is intended to serve as an index of *in-situ* compressive strengths. Failure to comply with proper testing procedures may produce results that are not representative of the compressive strengths and densities of *in-situ* foam concrete.

2.0 Casting

A. Specimens used for determining the unconfined compressive strength and the cured or *in-situ* density should be made by using non-absorbent, watertight and rigid cylinder molds. It is generally advisable to use cylinder molds with a cap that fits flush across the top of the sample (as opposed to a dome-shaped cap) so as not to create an open cavity of air. Top of mold must be sealed (preferably with a cap) to prevent evaporation. Three-inch diameter by six-inch length (3" x 6") cylindrical molds are preferable for use with foam concrete (ASTM C495-4.4).

B. If desired, use a thin film of a suitable (non-petroleum based) demolding liquid to coat the inside of disposable plastic molds. Always use such a coating when using reusable metal molds. Vegetable oil spray is an acceptable demolding liquid for foam concrete. Use a cloth wetted with demolding liquid to evenly coat all interior surfaces. Be sure that demolding liquid forms a thin film on all interior surfaces – remove any droplets or puddles of liquid before casting.

C. When obtaining foam concrete for test purposes, use a bucket (generally five-gallon) to draw sufficient material at the point of placement. Determine the unit weight of the fresh material (ASTM C796 – 8.7). After determination, proceed as quickly as possible to the sample casting station. Whenever possible, test samples should be cast close to the point of placement to avoid severe jostling from walking over rough terrain.

D. Cast samples as soon as possible after taking material from the point of placement, preferably within fifteen (15) minutes (ASTM C172).

E. Cast foam concrete cylinders in two lifts. Use a scoop or another mold to transfer the material from the bucket to each cylinder. Tap the sides of the mold **gently** after each lift to remove any trapped air pockets, overfilling the mold slightly when placing the second lift (ASTM C495-6.3). Do not strike off the molds before capping – this may produce an uneven or concave top surface unsuitable for testing.

F. Cap or cover specimens and place in protected curing location as soon as possible.

G. Since foam concrete is self-compacting, no compaction (rodding) should be used when making specimens.

H. Do not move filled molds during the first 24 hours following casting.

I. Prevent vibration by external sources during the first 24 hours following casting.

3.0 Curing and Handling

A. For on site curing, specimens should be protected against direct sunshine, precipitation, wind, or temperatures below 50° F. Cure on site for at least 24 hours following casting.

B. Remove specimens from the job site as soon as feasible after initial 24-hour curing. Specimens should be relocated to a controlled environment having a temperature of 73.4 ± 3°F as soon as possible.

C. Do not cure foam concrete specimens in a water tank unless foam concrete is protected from direct contact with water.

D. Handle specimens with care – low density foam concrete is fragile. During transport, protect specimens from freezing and impact.

4.0 Preparation

A. Remove samples from plastic molds no earlier than the day before compressive tests are to be performed. Do not use compressed air or a standard concrete stripping tool to remove specimens from molds. Use a razor (utility) knife with the blade protruding just enough to penetrate the wall of the mold. Do not allow knife to cut into specimen, as this may affect compressive strength to a large degree with the low strength range of the foam concrete material.

B. Determine the unit weight of each cylinder to be tested after removal from the mold. Use a balance of sufficient accuracy and precision, and be sure to measure length and diameter dimensions instead of simply assuming nominal values (ASTM C495-6.8).

C. If significant voids exist on the top or bottom of a particular sample, it is advisable to saw-cut the cylinder to remove the void. Ensure that the cut is perpendicular to the long axis of the cylinder. A length correction factor must then be employed to account for the changed L/D ratio.

D. Do not use neoprene caps or sulfur caps for testing. Sulfur caps will damage the samples when removed from the sulfur molds.

E. Use gypsum capping only for foam concrete specimens (ASTM C617). Mix gypsum powder and water in a thick paste (ASTM C617-6.2.3), place paste in a patty on a flat and level (usually glass) surface, and push sample into paste such that a thin layer of gypsum paste covers the specimen. Use a bulls-eye level to ensure that cylinder will not be eccentrically loaded (ASTM C617-Note 12). Wait for initial hardening of gypsum before repeating the process on the other end of the sample. Wait a minimum of one hour between casting of gypsum caps and strength testing. Recommended gypsum product is USG Hydrostone or equivalent.

5.0 Testing

A. Use a compression testing machine with a ball-jointed steel bearing block to contact the upper surface of the specimen, and a solid block on the bottom bearing surface of the specimen, to ensure loading over the entire cross-section of the cylinder (ASTM C39-5.2). If no ball joint is employed, cylinder may be loaded eccentrically, causing early or localized failure. Include the weight of the ball-jointed bearing block and any seating loads in the calculation to determine compressive strength. Testing machine/load cell shall be of the proper size, accuracy and sensitivity for the expected range of loading.

B. Apply loading continuously such that maximum load will be achieved in 65 ± 15 s (ASTM C495-7.2).

C. Make sure that the maximum (failure) load is achieved during compression testing.

D. Determine compressive strength according to ASTM C495, without oven drying (ASTM C796-8.9).

E. Note the failure mode and any unusual occurrences that occur during testing process.

SECTION 321400 - UNIT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete pavers set in aggregate and mortar setting beds.
2. Steel edge restraints.

B. Related Sections:

1. Section 300000 "Form 816 Site Work" for Class “A” concrete base under unit pavers.
2. Division 01, High Performance Buildings Requirements Section 018113.13 for credit 16a-38k-4(d)9 and 16a-38k-4(d)11.
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. Product Data: For materials other than water and aggregates.

C. Product Data: For the following:

1. Pavers.
2. Mortar materials.
3. Edge restraints.

D. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C 136.

E. Samples for Initial Selection: For the following:

1. Each type of unit paver indicated.
2. Exposed edge restraints involving color selection.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

1.6 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

PART 2 - PRODUCTS

2.1 CONCRETE PAVERS

A. Concrete Pavers: Solid paving units, made from normal-weight concrete with a compressive strength not less than 5000 psi (34 MPa), water absorption not more than 5 percent according to ASTM C 140, and no breakage and not more than 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C 67.

1. Thickness: 2-1/2”.
2. Face Size and Shape Type A: 18-by36-inch rectangle.
3. Face Size and Shape Type B: 12-by36-inch rectangle.
4. Color: As selected by Architect from manufacturer's full range.

2.2 EDGE RESTRAINTS

A. Steel Edge Restraints: Manufacturer's standard painted steel edging 3/16 inch (4.8 mm) thick by 4 inches (100 mm) high with loops pressed from or welded to face to receive stakes at 36 inches (900 mm) o.c., and steel stakes 15 inches (380 mm) long for each loop.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Border Concepts, Inc.
2. Collier Metal Specialties, Inc.
3. Oly-Ola Edging, Inc.

C. Color: Black

2.3 AGGREGATE SETTING-BED MATERIALS

A. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate.

2.4 MORTAR SETTING-BED MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type II.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 PREPARATION

A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

B. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.

3.3 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.

B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

D. Handle protective-coated brick pavers to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.

E. Joint Pattern: As indicated.

F. Tolerances: Do not exceed 1/16-inch (1.6-mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches (3 mm in 600 mm) and 1/4 inch in 10 feet (6 mm in 3 m) from level, or indicated slope, for finished surface of paving.

G. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.

1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.

3.4 AGGREGATE SETTING-BED APPLICATIONS

A. Blend dry sand and mortar for leveling course in proportions as indicated on drawings. Place leveling course and screed to a thickness of 1 inch (25 mm), taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.

B. Set pavers with a joint width of 1/16 inch (1.5 mm), being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines.

C. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf (16- to 22-kN) compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.

1. Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least 36 inches (900 mm) of uncompacted pavers adjacent to temporary edges.
2. Before ending each day's work, compact installed concrete pavers except for 36-inch (900 mm) width of uncompacted pavers adjacent to temporary edges (laying faces).
3. As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent edges unless they are within 36 inches (90 mm) of laying face.
4. Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted and cover leveling course on which pavers have not been placed with nonstaining plastic sheets to protect them from rain.

3.5 REPAIRING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

END OF SECTION 321400

SECTION 331000 - WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications sections, apply to work specified in this section.

1.2 DESCRIPTION OF WORK

A. Extent of water distribution system work is shown on Drawings.

B. Water distribution system work includes, but is not limited to, the following:
   1. Piping
   2. Control Valves
   3. Hydrants
   4. Pressure Reducing Valves
   5. Meters
   6. Casings
   7. Restoration
   8. Testing
   9. Disinfection

C. Comply with requirements of applicable Division 31 sections for excavation and backfilling required in connection with water distribution system.

D. Comply with requirements of applicable Division 03 sections for concrete work required in connection with water distribution system.

1.3 SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTORS-SUBMITTALS.

B. Product Data: Submit a minimum of five shop Drawings from each manufacturer of materials to be incorporated in the construction of water distribution system that material meets specifications of this section.

1.4 NOTIFICATIONS

A. Notify the Engineer of the starting date of water distribution system construction, in writing, five (5) days in advance of construction. Notify the Owner two (2) weeks in advance of locations for pressure taps in writing.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture and installation of water distribution system's products of types, materials, and sizes required, whose products have been satisfactory use in similar service for not less than 5 years.

PART 2 - MATERIALS

2.1 DUCTILE-IRON WATER PIPE FOR DIRECT BURY

A. Ductile-Iron water pipe in sizes three inches (3") to sixty-four inches (64") in diameter inclusive will be centrifugally cast conforming with the applicable requirements of the AWWA Standard for Ductile-Iron Pipe, Centrifugally Cast for Water, ANSI/AWWA C151/A21.51- (latest revision), as manufactured by:
   1. U.S. Pipe Co.
   2. Griffin Pipe
   3. American Pipe

B. Ductile-Iron pipe less than 16” diameter shall be Class 52 unless otherwise specified on the plans.

C. Ductile-Iron pipe 16” diameter and larger shall be minimum Class 51 or Pressure Class 250 unless otherwise specified on the plans.

D. All pipe joints (unless otherwise specified on the plans or these specifications) shall be mechanical and push-on joints for ductile-iron pipe shall conform to the AWWA Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings. ANSI/AWWA C111/A21.11- (latest revision). All ductile-iron pipe shall be double thickness cement lined in accordance with the requirements of the AWWA Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water. ANSI/AWWA C104/A21.4- (latest revision).

E. Pipes must be protected from contamination during transit.

2.2 DUCTILE IRON FLANGED PIPE AND FITTINGS

A. Ductile Iron Pipe with Threaded Flanges:
   1. Pipe shall be centrifugally cast ductile iron conforming to the requirements of AWWA C151 and C115 for material, dimensions, tolerance, tests, markings, and other requirements.
   2. Where required, pipe barrels and flanges shall have a taper pipe thread (NPT) in accordance with ANSI B1.20.1, with pipe diameters adapted to ductile iron pipe standard outside diameters.
   3. Flanged pipe shall be minimum Class 52 thickness and shall be furnished in standard laying lengths as specified or required.

B. Joints for Ductile Iron Flanged Pipe and Fittings:
   1. Flanged joints shall conform to the requirements of AWWA C110 and drilling and facing of flanges shall be in accordance with ANSI B16.1 Class 125 flanges unless otherwise specified.
   2. Flanged ductile iron pipe and fittings shall be furnished complete with all necessary joint accessories consisting of natural or synthetic rubber gaskets, $^{1}/_{8}$-inch thick, full face; and, nuts, bolts and washers, unless otherwise specified.
   3. All nuts, bolts and washers for flanges and accessories shall conform to ANSI B18.2.1 and ANSI B18.2.2, respectively and shall be Type 304 stainless steel, high strength, low alloy steel or fluorocarbon coated as specified herein.

C. Flange Fillers, Blind Flanges and Reducing Companion Flanges:
   1. Conform to the requirements of AWWA C115 for material, dimensions, tolerance, tests, markings and other requirements.

2. Drilling and facing of flanges shall be in accordance with ANSI B16.1, Class 125 flanges unless otherwise specified.
3. Flanged fillers, blind flanges and reducing companion flanges shall be furnished complete with all necessary joint accessories consisting of natural or synthetic rubber gaskets, $^{1}/_{8}$-inch thick, full face; and, nuts, bolts and washers, unless otherwise specified.
4. Threaded outlets or taps, (Mueller threads), shall be provided in blind flanges as specified or required.
5. All nuts, bolts and washers for flanges and accessories shall conform to ANSI B18.2.1 and ANSI B18.2.2, respectively and shall be Type 304 stainless steel, high strength, low alloy steel.

2.3 POLYETHYLENE TUBE ENCASING

A. Polyethylene encasement shall conform with the applicable requirements of the AWWA Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems, ANSI/AWWA C105/A21.5- (latest revision) as supplied by:
   1. U.S. Pipe Co.
   2. Griffin Pipe
   3. American Pipe

B. The polyethylene material shall have a minimum thickness of 0.008 inches (8 mil). The minus tolerance of thickness shall not exceed 10 percent of the nominal thickness.

C. Tube size or sheet width for each size of pipe shall be as follows:

Nominal Pipe Size	Flat Tube Width	Sheet Width
3	14"	28"
4	16"	32"
6	20"	40"
8	24"	48"
12	30"	60"
16	37"	74"
24	54"	108"

D. Tape required to complete the installation shall be approximately two (2") inches wide, plastic backed adhesive tape as manufactured by:
   1. Polyken #900
   2. Scotchrap #50
   3. Hansen Industries

2.4 POLYVINYL CHLORIDE PIPE FOR DIRECT BURY

A. Polyvinyl Chloride Pipe in sizes four (4”) inches to twelve (12”) inches in diameter inclusive shall conform to the applicable requirements of the AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inches through 12 inches, for Water Distribution, ANSI/AWWA C900 – (latest revision).

B. Pipe shall be DR-18 (Pressure Class 235) plain end and elastomeric-gasket integral wall thickened bell-end. The outside diameter (OD) dimensions of the pipe shall conform with the outside diameter (OD) dimensions of Ductile Iron Pipe. All pipe shall be manufactured and tested in the United States.

C. Pipes must be protected from contamination and discoloration during transit.

2.5 DETECTABLE TAPE

A. Detectable tape, for laying directly above PVC & HDPE potable water main piping installed by open cut, shall be magnetic marker tape, colored blue, three inches (3") wide, labeled "CAUTION WATERLINE BURIED BELOW", and be as manufactured by:
   1. Reef Industries Inc.
   2. C.H. Hanson Products
   3. Paul Potter Warning Tapes, Inc.

B. Detectable tape, for laying directly above PVC & HDPE non-potable water main piping installed by open cut, shall be magnetic marker tape, colored purple, three inches (3") wide, labeled "NON POTABLE WATERLINE", and be as manufactured by:
   1. Reef Industries Inc.,
   2. C.H. Hanson Products
   3. Paul Potter Warning Tapes, Inc.

2.6 FITTINGS

A. Ductile Iron Fittings
   1. Ductile-Iron fittings for three inches (3") diameter and greater shall be Class 350 and conform to the AWWA Standard for Ductile-Iron Compact Fittings for Water Service, ANSI/AWWA C153/A21.53-(latest revision) as manufactured in the United States by:
      a. Tyler Pipe Co.
      b. U.S. Pipe Co.
      c. American Pipe

   2. All ductile-iron fittings shall be double thickness cement lined in accordance with the requirements of the AWWA Standard for Cement - Mortar Lining for Ductile-Iron Pipe and Fittings for Water, ANSI/AWWA C104/A21.4- (latest revision).
   3. All ductile-iron fittings shall have mechanical joint ends and be furnished with sufficient quantities of accessories. All nuts and tee bolts for fittings shall be Flourocarbon coated, high strength, corrosion resistant, low alloy steel or Type 304 Stainless Steel and shall conform to AWWA C-111/A21.11-(latest revision). Restrained joints utilizing mechanical joint wedge action retainer glands will be required.
   4. Where use on ductile-iron pipe is approved by the Engineer, restrained joint ductile-iron fittings shall be:
      a. "Super-Lock" joint as manufactured by Clow-McWane, Inc.
      b. US Pipe TR Flex
      c. American Cast Iron Flex Ring

2.7 BALL VALVES

A. Ball valves shall conform to the requirements of the AWWA Standard for Underground Service Line Valves and Fittings, ANSI/AWWA C800- (latest revision).

B. Ball valves shall have brass body, "O" ring seals and quarter-turn check. Plastic body valves will not be acceptable.

2.8 RESILIENT SEATED GATE VALVES

A. Valves three inches (3”) to twelve inches (12”) shall be iron body, resilient seated conforming to the requirements of the AWWA Standard for Resilient-Seated Gate Valves, for Water Supply Service, ANSI/AWWA C509- (latest revision), as manufactured by:
   1. Mueller Co.
   2. Kennedy Valve Mfg. Co.
   3. American

B. Valves fourteen inches (14”) to forty-eight inches (48”) shall be iron body, resilient seated conforming to the requirements of the AWWA Standard for Reduced Wall, Resilient-Seated Gate Valves, for Water Supply Service, ANSI/AWWA C515- (latest revision), as manufactured by
   1. Mueller Co.
   2. Kennedy Valve Mfg. Co.
   3. American

C. All valves shall have non-rising stems, "0" ring seals (capable of being replaced under pressure), two inch (2") square operating nut, stainless steel bonnet bolts and nuts, open counterclockwise (to the left), and have mechanical joint ends, unless specified otherwise. Sufficient quantities of accessories shall be provided to install the valve in the pipeline.

D. Valves up to 12” diameter shall be designed to operate vertically in a horizontal pipeline.

E. Valves 14” diameter and larger shall be designed to lie horizontally, unless otherwise noted, and shall be equipped with bevel gear operator so the valve can be operated with a key held in the vertical position. Valves installed in the horizontal position shall have a cleanout port at the bottom of the wedge guides.

F. Gate valves three inches (3”) to twelve inches (12”) shall be designed for a minimum design working pressure of 200 psig. Gate valves fourteen inches (14”) to forty-eight inches (48”) shall be designed for a minimum design working pressure of 150 psig.

G. All gate valves shall be designed for a minimum test pressure equal to the test pressure specified for the watermain.

2.9 BUTTERFLY VALVES

A. Butterfly valves shall conform to the requirements of the AWWA Standard for Rubber Seated Butterfly Valves, ANSI/AWWA C504- (latest revision).

B. All butterfly valves and their operators shall be designed for buried and submersible service. Operators shall be attached to the body of the valve so that the valve may be installed in a horizontal pipeline and the valve operated with a key held in a vertical position. The operator shall have a two inch (2") square nut and open counterclockwise (to the left).

C. All butterfly valves shall have mechanical joint ends unless otherwise specified and be furnished with sufficient quantities of accessories. All valves shall be designed to withstand a minimum working pressure of 150 psig and a minimum test pressure equal to the test pressure specified for the watermain. Butterfly valves shall be minimum Class 150B and be:
   1. Groundhog Model as manufactured by Henry Pratt Co.,
   2. Mueller Lineseal III as manufactured by Mueller Co.
   3. DeZurik

D. All butterfly valves shall be bi-directionally tested.

2.10 TAPPING SLEEVES & VALVES

A. Tapping sleeves for four inch (4”) through twenty-four inch (24”) diameter pipe shall be ductile iron, or stainless steel constructed of Type 304 (18-8) stainless steel, and be built in two halves, for assembly around the main. Rubber gaskets shall be provided for a watertight joint the full length of the sleeve. Bolts holding the two halves shall be closely spaced to insure uniform gasket pressure. Ductile Iron Tapping Sleeve ends shall be mechanical joint with split rings and gaskets sized for the pipe being tapped. Sufficient accessories shall be provided to install the sleeve on the pipe. The outlet end of the sleeve shall be flanged and the entire sleeve shall be designed to withstand a minimum 150 psi working pressure. Tapping sleeves which incorporate a single ring gasket which seals one side of the sleeve against the face of the pipe around the tap hole <u>will not</u> be accepted.

B. Ductile Iron Sleeves for tapping asbestos-cement pipe shall be as manufactured by Mueller Co. Model H-619 or equivalent product. Acceptable manufacturers include:
1. Mueller
2. JCM
3. Ford

C. Ductile Iron Sleeves for tapping cast iron, ductile iron or PVC pipe shall be as manufactured by Mueller Co. Model H-615 or equivalent product. Acceptable manufacturers include:
1. Mueller
2. JCM
3. Ford

D. Stainless Steel Sleeves for tapping asbestos-cement, cast iron, ductile iron or PVC pipe shall be as manufactured by Mueller Co. Model H-304 or equivalent product. Acceptable manufacturers include:
1. Mueller
2. JCM
3. Ford

E. Tapping valves three inches (3”) to sixteen inches (12”) shall be iron body, resilient seated conforming to the applicable requirements of the AWWA Standard for Resilient – Seated Gate Valves for Water Supply Service, ANSI/AWWA C509- (latest revision) as manufactured by:
1. Mueller Co.
2. Kennedy Valve Co.
3. American

F. Valves fourteen inches (14”) and larger shall be iron body, resilient seated conforming to the requirements of the AWWA Standard for Reduced Wall, Resilient-Seated Gate Valves, for Water Supply Service, ANSI/AWWA C515- (latest revision), as manufactured by:
1. Mueller Co.
2. Kennedy Valve Mfg. Co.
3. American

G. All tapping valves shall have non-rising stems, “O” ring seals (capable of being replaced under pressure), two inch (2”) square operating nut, stainless steel bonnet bolts and nuts, and open

counterclockwise (to the left). Inlet ends shall be flanged to fit the respective tapping sleeve to which they will be attached and the outlet ends shall be mechanical joint. Sufficient quantities of accessories shall be provided to complete the assembly and connect the valve to the new pipeline.

H. All tapping valves shall be designed for a minimum design working pressure of 200 psig and a minimum test pressure equal to the test pressure specified for the watermain.

I. Tapping valves three-inches (3”) to twelve inches (12”) shall be designed to operate vertically in a horizontal pipeline.

J. Tapping valves larger than twelve inches (12") shall be designed to lie horizontally, unless otherwise noted, and shall be equipped with a bevel gear operator so the valve can be operated with a key held in the vertical position. Valves installed in the horizontal position shall have a cleanout port at the bottom of the wedge guides.

2.11 HYDRANT

A. Hydrants shall conform to the requirements of the AWWA Standard For Dry-Barrel Fire Hydrants, ANSI/AWWA C502-(latest revision), Owner’s standards, and as follows:
   1. Type - "breakaway" with "0" ring seals
   2. Valve opening – 5 ¼"
   3. Inlet - 6" mechanical joint
   4. Nozzles - one 4 ½" pumper nozzle and two 2 ½" hose nozzles, all with National Standard Threads. Caps with chains will be required for all outlets.
   5. Bury - designed to allow 5 feet of cover on the branch and allow 15 to 18 inches between the centerline of the lowest nozzle and the surface of the ground
   6. Operating nut – 1 ½” pentagon
   7. Direction of opening - left (counterclockwise)
   8. Color – OSHA Safety Yellow (manufacturer applied)
   9. Valve shall open against pressure and close with pressure
   10. All working parts are to be in the bonnet of the hydrant above the nozzles, not in the waterway
   11. Valve opening limit stops shall be in the shoe of the hydrant
   12. All hydrants shall be as manufactured by:
      a. Mueller A-423
      b. Kennedy Valve Mfg. Co. of the Figure K81-D/Guardian Pattern
      c. American Flow Control-American Darling B84B
   13. All hydrants shall be furnished with weeps unless otherwise noted or determined in the field by the Engineer.

B. All new hydrants shall have touch-up paint applied in the field as necessary after installation with matching paint color by:
   1. Rust-Oleum,
   2. Pennsbury “Hydrant-Hide”,
   3. Con-Lux Steel Guard

C. One hydrant operating wrench shall be furnished for every twenty (20) hydrants with a minimum of two (2) required.

2.12 HYDRANT MARKERS

A. Hydrant markers shall be provided as follows:
   1. 5-foot long, UV resistant fiberglass shaft with 6-inch wide reflective red & white striping tape
   2. Heavy duty, MIL SPEC zinc plated, carbon steel spring mount
   3. Mounted on hydrant bonnet bolt
   4. All hydrant makers shall be by
      a. RoDon Corp.
      b. Hy-Viz
      c. Pro-Mark

B. One hydrant marker shall be mounted on each new hydrant installed along CONNDOT right-of-way unless otherwise noted.

2.13 POST HYDRANT

A. Hydrants shall conform to the following requirements:
   1. Valve opening – 1½”.
   2. Inlet – 2”.
   3. Nozzle – one 1½” nozzle with National Standard Thread.
   4. Bury – designed to allow 4½ feet of cover on the branch and allow 15 to 18 inches between the centerline of the nozzle and the surface of the ground.
   5. Operating nut – Square or Pentagon.
   6. Direction of opening – left (counterclockwise).
   7. Hydrants shall be as manufactured by
      a. Kupferle Foundry Company
      b. M & H Valve
      c. Gil Industries

B. One hydrant operating wrench shall be furnished for every twenty (20) hydrants with a minimum of two (2) required.

2.14 YARD HYDRANTS/SPIGOTS

A. Yard Hydrants/Spigots shall conform to the following requirements:
   1. Type - Freezeless post
   2. Casing – 1 1/4” Galvanized Steel Pipe
   3. Operating Rod – 3/8” Galvanized Steel Pipe
   4. Inlet - 1” Female NPT
   5. Outlet – ¾” brass male hose nozzle thread
   6. Outlet Attachment – ¾” hose connection Backflow Preventer: of brass and stainless steel construction; with two, molded rubber diaphragm check valves; with stainless steel stop collar and stop screw for theft resistance; and with male outlet hose threads.
   7. Outlet Attachment – ¾” anti-siphon vacuum breaker: of brass and stainless steel construction; with single, molded rubber diaphragm check valve; with stainless steel stop collar and stop screw for theft resistance; and with male outlet threads filed smooth to prevent hose connection.
   8. Bury - designed to allow a minimum of 5 feet of cover on the inlet and allow 30 inches minimum between the outlet nozzle and the surface of the ground
   9. Operating Mechanism – Top mounted lever & rod

10. Drain – Tapped 1/8” NPT [with plug installed]
11. Color – Blue
12. Yard hydrants/spigots shall be as manufactured by
    a. Woodford Model Y2
    b. Merrill
    c. Zurn

2.15 VALVE BOXES

A. Valve boxes shall be as manufactured in the United States by
   1. Mueller Co.,
   2. Bibby-LaPerle, USA
   3. Sigma

B. Valve boxes as follows:
   1. Valve boxes for gate valves and butterfly valves 4” and larger shall be two piece adjustable screw type, 5¼” shaft, with base to fit the valve on which it is to be installed.
   2. Valve boxes for 2” and 3” valves shall be 4½” shaft, and as noted above.
   3. Valve boxes shall have the word “WATER” cast on the lid.

2.16 ANCHORAGES

A. General: Provide anchorages for tees, plugs, caps, bends, valves, couplings and pipe as shown on the plans and as follows:
   1. Retainer glands for ductile iron pipe to fit mechanical joints shall be:
      a. wedge action EBAA Iron Series 1100
      b. Uni-Flange Series 1400
      c. Smith Blair
   2. Retainer glands for PVC pipe to fit mechanical joints shall be:
      a. EBAA Iron Series 2000 PV
      b. Uni-Flange Series 1500
      c. Smith Blair
   3. Restraint harnesses for push joint ductile iron pipe shall be:
      a. wedge action EBAA Iron Series 1700 Megalug
      b. Uni-Flange Series 1450
      c. Smith Blair
   4. Restraint harnesses for push joint PVC pipe shall be:
      a. EBAA Iron Series 1600
      b. Uni-Flange Series 1350
      c. Smith Blair
   5. Restraint harnesses for cast iron pipe joints shall be of the friction clamp type with threaded rods.
   6. All bolts and nuts for joints shall be Fluorocarbon coated, high strength, corrosion resistant, low alloy steel or Type 304 Stainless Steel conforming to ANSI/AWWA C-111/A21.11-(latest revision).
   7. Thrust Blocks shall be 3000 psi concrete.

2.17 ANCHOR PIPE, COUPLINGS, TEES AND ELBOWS

A. All M.J. anchoring pipe, couplings, tees and elbows shall be as manufactured by:
   1. Tyler Pipe Co.
   2. Clow
   3. Star

B. They shall be cement-lined in accordance with the requirements of the AWWA Standard for Cement - Mortar Lining for Ductile Iron Pipe and Fittings for Water, ANSI/AWWA C104/A21.4-(latest revision) and the thickness shall not be less than 1/8". All anchoring pipe, couplings, tees and elbows shall meet pressure requirements equivalent to that for pipe.

C. All nuts and bolts for joints shall be Flourocarbon coated, high strength, corrosion resistant, low alloy steel or Type 304 Stainless Steel and shall conform to AWWA C-111/A21.11 (latest revision).

2.18 COUPLINGS AND REPAIR CLAMPS

A. Couplings and clamps shall be as manufactured by:
   1. Dresser Manufacturing Div. of Dresser Industries Inc.
   2. Smith-Blair Inc.
   3. Ford Meter Box Co., Inc.

B. Gaskets for couplings shall be molded rubber, Dresser grade 27, Smith-Blair grade 30, Ford SBR compound, or equal. Gaskets for repair clamps shall be molded rubber, grade 60, SBR compound.

C. Couplings shall be of the Dresser style #38 or #138, Smith-Blair type #411 or #441, Ford style FC1, or equal. Joint clamps shall be of the Dresser style #160, Smith-Blair type #274, Ford style FBC, or equal. Transition couplings shall be Dresser style #162, Smith-Blair type #441, Ford style FC2A, or equal. Couplings and joint clamps shall be painted with one coat of shop primer.

D. Repair clamps shall be full circle, stainless steel, single band provided in minimum length of twelve inches (12") They shall be of the Smith-Blair type #260, Ford flex style FS1, or equal, and be equipped with either Type 304 stainless steel bolts and nuts or high strength, low alloy steel bolts and nuts having a fluorocarbon SC-1 and shall conform to AWWA C-111/A21.11 (latest revision). Repair clamps with a separate keeper bar will not be accepted. Cast iron or ductile iron fingers are not allowed.

2.19 COUPLINGS

A. Couplings may be used only when approved by the Owner and/or Engineer.

B. Center sleeve shall be fabricated of high strength carbon steel tubing with NFS-61 approved, fusion bonded epoxy coating on both interior and exterior.

C. Compression end rings to be either one bolt or two and fabricated of carbon steel.

D. Buried or submerged couplings shall be provided with Type 304 stainless steel bolts and nuts with anti-seize coating to prevent galling.

E. Gaskets shall be two layered of which inner ring is removable to expand the range of the coupling. Gasket material shall be EPDM according to NSF61.

F. Manufacturers:
   1. Hymax
   2. Smith Blair
   3. Romac

2.20 SERVICE MATERIALS

A. Corporation Stops:
   1. Corporation stops shall conform to the requirements of the AWWA Standard for Underground Service Line Valves and Fittings, ANSI/AWWA C-800-(latest revision) and the following supplemental details:
      a. Service components in contact with potable water shall be manufactured from low-lead or no-lead brass alloys either CDA/UNS C89520 or C89833, and comply with the latest requirements of the Federal Safe Drinking Water Act. Brass components that do not come in contact with potable water shall be made from CDA/UNS C83600 alloy.
      b. ¾” through 2" shall have inlet threads and compression outlet connection for copper tube service pipe.
      c. Fittings shall be stamped or embossed indicating that the product is manufactured from low-lead alloys.
      d. Manufacturers:
         1) Mueller Co
         2) Ford
         3) AY McDonald

B. Curb Stops:
   1. Curb stops shall conform to the requirements of the AWWA Standard for Underground Service Line Valves and Fittings, ANSI/AWWA C-800- (latest revision) and must include the following supplementary details:
      a. Service components in contact with potable water will be manufactured from no-lead or low-lead brass materials and comply with the latest requirements of the Federal Safe Drinking Water Act.
      b. Compression connections for copper tube service pipe on inlet and outlet will be required.
      c. Fittings shall be stamped or embossed indicating that the product is manufactured from low-lead alloys.
      d. One curb stop operating key shall be furnished for every one hundred (100) curb stops with a minimum of two (2) required.
      e. Manufacturers:
         1) Mueller Co.
         2) Ford
         3) AY McDonald

C. Curb Boxes:
   1. Curb boxes shall be screw type adjustable, 2½" shaft, size 94E or 95E for ¾” and 1" curb stops.
   2. For 1½” and 2-inch curb stops, use adaptor base.
   3. Each curb box shall be supplied with a stainless steel rod and pin with guide ring unless otherwise noted or determined in the field by the Owner and/or the Engineer.
   4. The word “WATER” shall be cast on the lid.

D. Service Pipe:

1. Copper service pipe shall be provided as required in sizes 3/4" through 2" diameter. Copper service pipe shall be Type K copper water tube in accordance with ASTM Specification B88. Copper service pipe shall be manufactured and tested in the United States.

E. Service Saddles:

1. Service saddles shall be double strapped bronze with O-ring seal cemented in place as manufactured by Mueller Co., BR2B Series, or equal.
2. Saddles shall be manufactured from CDA/UNS C83600 brass alloy.
3. Manufacturers:
   a. Mueller Co
   b. Ford
   c. AY McDonald

F. Water Meters:

1. Individual residential or business water meters shall be provided as required in sizes 5/8” x ¾”, ¾-inch, and 1-inch. Existing meters are to be replaced with new meters of the same size.
2. All new meters are to be installed horizontally regardless of position of existing meter.
3. Water meters shall be remote radio read with integral antenna for installation either inside the business or residence, or within outside meter tile sets/pits. Contractor shall be responsible to furnish and install the correct style meter (inside or pit version) for the correct application.
4. Water meters shall be as manufactured by Neptune Technology Group, Model “E-coder R900i”.

G. Water Meter Tile Sets:

1. The water meter tile set shall be rigid PVC, high insulating “R” value body meter box specially designated for buried meter applications.
2. The water meter tile set shall be designed such that the meter is easily accessible and braced for additional stabilization. No bottom is to be provided.
3. A closed-cell insulation pad or a double lid cover system shall be provided to prevent freezing.
4. The water meter tile set shall be suitable for a minimum depth of cover of 4½ feet over the water service tubing.
5. A locking cast iron lid shall be furnished for each tile set.
6. The water meter tile set shall be furnished complete with male I.P. thread inlet and outlet connections, full port angle key at meter inlet, dual check valve at meter outlet, coupling and fittings ready for a complete meter installation.
7. Where smaller sized meters are to be installed on larger service lines, as noted on the plans, in the specifications, or as determined in the field by the Owner and/or Engineer, the Contractor shall provide necessary size tileset and fittings to allow installation of the smaller meter with provisions for future installation of a larger meter to match the diameter of the new service line.
8. Manufacturer:
   a. Mueller/McCullough Thermo Coil Meter Box for $^{5}/_{8}$-inch x ¾-inch, ¾-inch, & 1-inch meters, and/or ¾-inch & 1-inch service lines;
   b. Ford Pit Setter – PD BHH-288-18-60 for $^{5}/_{8}$-inch x ¾-inch (or PD BHH-388-18-60 for ¾-inch meters) and/or ¾-inch service lines;
   c. Ford Pit Setter – PD BHH-488-20-60 for 1-inch meters, and/or 1-inch service lines;
   d. Mueller/McCullough EZ-Vault Meter Setter for 1 ½-inch and 2-inch meters;
   e. Ford Pit Setter-PMBB-688-36HB-60 for 1 ½-inch meters;

f. Ford Pit Setter-PMBB-788-36HB-60 for 2-inch meters;

2.21 SAMPLING STATION

A. The Sampling Station shall be a self-contained unit with ¾" inlet and ¾" unthreaded, brass nozzle outlet operated by an attached handle.

B. The sampling station shall be housed in an above grade, lockable, aluminum or UV resistant thermoplastic enclosure.

C. All working parts and valves shall be brass.

D. ¼-inch copper vent tube/pump out connection shall be furnished with a brass petcock.

E. Inlet piping between the watermain and the sampling station shall be ¾-inch Type "K" copper tubing.

F. Contractor shall furnish to the Owner one manual hand pump compatible with the sampling station provided.

G. The sampling station shall be designed for "cold climate" as manufactured by:
   1. Kupferle Foundry Co. - #88 Eclipse;
   2. GIL Industries, Inc.;
   3. Hydro-Guard

2.22 AUTOMATIC FLUSHING DEVICE/SAMPLING STATION

A. An automatic flushing device shall typically be furnished for all dead end mains and for all cul-de-sacs as noted on the plans or as determined in the field by the Engineer. Temporary dead ends, such as at subdivision phase lines, shall be considered dead end mains.

B. The flushing device shall be operated by a solenoid valve and an automatic, self contained, programmable, battery operated, digital controller.

C. The flushing device shall be housed in an above grade, lockable, UV resistant thermoplastic enclosure.

D. Inlet piping between the watermain and flushing device shall be 2-inch diameter, Type "K" copper tubing with brass valves & fittings as required.

E. A 6-inch diameter (minimum) discharge line must be provided from the flushing device to outlet to a storm sewer system, drainage structure, or open drainage system unless otherwise noted or as determined in the field by the Engineer.

F. The automatic flushing device shall be designed for "cold climate", self-draining, non-freezing, as manufactured by:
   1. Kupferle Foundry Co. - #9800 Eclipse;
   2. Hydro-Guard – Model HG-4;
   3. Gil Industries, Inc.

2.23 PRECAST CONCRETE

A. The Contractor shall provide all materials, labor, equipment, supervision and incidentals required to furnish and install the concrete structures shown on the Drawings and specified herein.

B. The Contractor shall coordinate installation of structures with installation of adjacent pipe valves and items that must be installed in the concrete in a manner acceptable to the Engineer.

C. Depth, width and length shall be as shown on the Plans.

D. Chambers, frames and covers shall be designed for H-20 loads and any additional indicated loads.

E. All precast structures shall conform to the requirements of concrete work. See Section 033000.

F. The Contractor shall submit a detailed drawing, indicating the design load of structures, signed and sealed by a licensed professional Engineer.

2.24 WATER METERS

A. Water meters shall conform to AWWA C-703- (latest revision). The water meter location, size and manufacturer shall be as shown on the plans.

2.25 AUTOMATIC AIR RELEASE VALVE

A. The Automatic Air Release Valves shall be float operated and shall incorporate a compound lever mechanism to enable to valve to automatically release accumulated air from a fluid system while the system is pressurized and operating.

B. The Automatic Air Release Valve shall close drop tight, incorporating an adjustable Buna-N orifice button. All internal metal parts shall be stainless steel. The float shall be of stainless steel and be capable of withstanding a test pressure of 1000 psig. The linkage/lever mechanism shall be able to be removed from the valve without disassembly of the mechanism, and shall be designed to prevent jamming. The body and cover shall be of cast iron conforming to ASTM A126 Class B, and shall be designed to withstand a test pressure of 450 psig.

C. The Automatic Air Release Valves in the size(s) and configurations (s) noted on the plans shall be as manufactured by:
   1. GA Industries, Figure 920
   2. Val-Matic, Series No. 38
   3. Crispin, PL Series

2.26 AIR/VACUUM RELEASE VALVE

A. The Combination Air Valve shall consist of a KINETIC Air & Vacuum Valve and an Air Release Valve contained in a single body housing. The valve shall be designated to exhaust large amounts of air during filling, to release small amounts of accumulated air during operation and to admit large amounts of air upon impending vacuum during draining.

B. The inlet shall be the nominal size of the valve and the outlet shall be the same size as the inlet. Body and cover shall be of cast iron conforming ASTM A126, Class B. The Air & Vacuum portion of the valve shall be designated to exhaust air at up to sonic velocity without blowing shut. There shall be no baffles, deflectors, or stems. The floats shall be spherical and shall be capable of withstanding a test pressure of 1000 psi. The Air Release portion shall have a stainless steel of leverage mechanism and float. The small orifice shall be stainless steel and have a rubber seat.

C. Kinetic Compact Combination Air Valves shall be manufactured by:
   1. GA Industries, Inc., Mars, PA their Figure No. 945, with 1/8” Orifice
   2. Crispin Mulitplex Mfg. Co., Berwick, PA their Series UL20, with ¼” orifice
   3. Val-Matic Inc., Elmhurst, IL their Model 202C.2.

2.27 BACKFLOW PREVENTERS

A. The backflow preventer assembly shall be a double check backflow prevention assembly consisting of two internally loaded, independently operating check valves, located between two tightly closing resilient –seated shutoff valves. The assembly shall include four properly placed resilient-seated test cocks.

B. The assembly shall have FDA approved epoxy coated cast iron check valve bodies with bronze check seats.

C. The assembly shall be suitable for supply pressure up to 175 psi and a water temperature range of 33°F to 110°F continuous and 140°F intermittent.

D. The assembly shall have the following features:
   1. Replaceable bronze seats
   2. Resilient seated gate valve shut-offs
   3. No special tools required for servicing

E. Backflow preventers shall conform to AWWA C510- (latest revision) and all State and Local Regulatory Requirements. The location, size and manufacturer shall be as shown or noted on the plans.

2.28 RIGID-FOAM INSULATION

A. Use rigid-foam insulation of the sizes and types indicated on the Contract Drawings or as directed by the Engineer to protect water mains from potential freezing conditions. Rigid-foam insulation shall possess the following characteristics:

   1. Rigid closed-cell, expanded polystyrene board
   2. 1.5-inch thick extruded board
   3. Comply with FS-HH-I-524, Type II, Class B
   4. Compressive strength: 30 PSI
   5. Water absorbtion: 1.0 perm per inch maximum
   6. Thermal conductivity: (K-value at 75 deg. F) – 0.2

B. All insulation jacketing and related materials to be utilized in conjunction with this project shall conform to the Contract Drawings and Specifications and must be submitted to the Engineer for approval prior to use.

2.29 POST INDICATOR VALVE

A. FM Global post indicator valves shall be provided at all Underground fire protection feeds into building. Post indicator valves shall be manufacturers by:

   1. Kennedy
   2. Clow
   3. Mueller

PART 3 - EXECUTION

3.1 COORDINATION WITH OTHER CONTRACTS

A. The water distribution system to be connected to is being constructed under a separate construction contract. The Contractor is required to coordinate schedule and construction installation with that Contractor before testing and tie in will be permitted.

3.2 INSTALLATION

A. Pressure Taps: After installation of the tapping sleeve, but prior to tapping, the sleeve shall be pressure tested to determine if it is watertight and disinfected. The ductile iron pipe-tapping sleeve shall be tested to a water test pressure of 150 psi. If any leakage does occur, the sleeve shall be made watertight in a customary manner. Tapping sleeves and valves shall also be disinfected by swabbing with chlorine solution prior to tapping.

B. After each tap has been completed, the Contractor shall keep the tapping area uncovered for one hour to determine if any leakage has occurred. If leakage has occurred, the tap shall be made watertight in a manner acceptable to the Engineer.

C. The valves shall be kept closed until approval from the Engineer is given to open the valve.

D. Polyvinyl Chloride Pressure Pipe: Install in accordance with AWWA Manual M-23 and manufacturers' instructions.

E. Push joint PVC waterpipe shall not be deflected when changes in directions are required; mechanical joint fittings shall be used for this purpose.

F. Thrust restraints for water main piping shall be installed at all changes in direction, changes in size, dead ends and other locations where shown or noted in the Contract Documents or as determined in the field by the Engineer.

G. Polyvinyl chloride (PVC) installed by open cut shall have a magnetic tape marker laid directly above the pipe for the full length of the pipe and approximately 18 inches below the ground surface.

H. Ductile-Iron Pipe: Install in accordance with recommended procedures of AWWA C-600- (latest revision).

I. Where ductile iron pipe, valves or fittings are installed, they shall be installed with polyethylene tube encasement held in place with adhesive tape.

J. The cost for installing the polyethylene tube encasement shall be included in the unit prices bid for installing the pipe, valves or fittings.

K. Polyethylene Tube Encasement: Install in accordance with ANSI/AWWA C105/A21.5-(latest revision) and manufacturer’s instructions.

L. If existing transite pipe is in need of rework to allow construction or similar activity to take place within the vicinity of the new line, then replacement shall be with ductile iron pipe of the same diameter with appropriate matching couplings and fittings.

M. Control Valves: Install in accordance with manufacturer's instructions.

N. Hydrants: Install in accordance with AWWA recommended standards and manufacturer's instructions.

O. Interior Inspection: Inspect conduit to determine whether line displacement or other damage has occurred.
   1. If the inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects, correct such defects to satisfaction of Engineer.

P. Cleaning Conduit: Clear interior of conduit of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed.

Q. Place plugs in end of uncompleted pipeline at end of day or whenever work stops.

PART 4 - TESTING (As per ANSI/AWWA C600 latest revision for DIP; ANSI/AWWA C605 for PVC; latest revision), and FM Global requirements.

4.1 TESTING AND DISINFECTION PROCEDURE

A. Prior to performing any work as described in this part, the Contractor shall submit to the Engineer for approval a flushing, testing and/or disinfection procedure. The procedure shall include when the work will be performed, source points for water, flush points for water, length and location of waterline to be included, and de-chlorination procedures.

B. Flushing and hydrostatic testing shall be performed in accordance with Data Sheet 3-10, *Installation and Maintenance of Private Service Mains and Their Appurtenances*. No 2 in. drains is not an acceptable method of flushing lead-ins. All flushing should be conducted as follows:

Pipe Size (in.)	Minimum Flow Rate (gpm)
6	880
8	1,560
10	2,440
12	3,520

C. FM Global Form 85A, *Contractor's Material & Test Certificate for Automatic Sprinkler Systems*, shall be completed and submitted to FM Global by the Contractor for review and comment.

D. FM Global Form 85B, *Contractor's Material & Test Certificate for underground Piping*, shall be completed and submitted to FM Global by the Contractor for review.

E. Contractor to provide all tools, power, materials and chemicals necessary to disinfect, test, flush and de-chlorinate the water main and appurtenances, in conformance with AWWA Standards C600 and C651 and Standards stated in Section 19-13-B102 of Regulations of Connecticut State Agencies.

4.2 PRELIMINARY FLUSHING

A. Prior to the pressure and leakage tests, and line valve tests, each potable water system shall be flushed until the water runs clear. Each valved system of the newly installed piping system shall be flushed separately with potable water from the public supply.

B. When filling of the new line for flushing is achieved by accepting water from an existing water line, the Contractor shall, as a minimum, maintain an open outlet on the new work at all times that the connection between the existing water line and the new work is open. After initial filling/flushing, the Contractor shall, as a minimum, furnish and install a reduced pressure zone (RPZ) backflow preventer at the source of the supply to protect against the backflow of water from the new line into

the existing line. When water is obtained from existing waterlines for these purposes, the water shall be metered.

4.3 Perform hydrostatic testing of completed conduit lines in accordance with the following:

A. Test No. 1 - Pressure Test:
   1. Assumptions:
      a. AWWA requirement of hydrostatic test pressure to be based on the elevation of the lowest point in the line or section under test corrected to the elevation of the test gauge.
      b. Test pressure shall equal 150% of working pressure at point of test, but not less than 125% of normal working pressure at the highest elevation.
      c. Test pressure shall be minimum 150 psi for DIP, PVC and PE up to 12-inch diameter.
   2. The maximum length of pipeline to be tested at any one time shall not exceed 6,000 lineal feet.
   3. The pressure gauge must have markings at no greater than 2 psi increments to allow accurate readings.

B. Test No. 2 - Leakage Test:
   1. The hydrostatic pressure shall be the same as determined for Test No. 1 Pressure Test.
   2. The leakage test may be conducted concurrently with the pressure test.
   3. The maximum length of pipeline to be tested at any one time shall not exceed 6,000 lineal feet or valve to valve, whichever is less.
   4. The leakage under the conditions of the test for water pipe shall be determined by the following formula and as per AWWA standards:
      a. For Ductile Iron and push joint PVC Pipe:

$$L = \frac{ND\sqrt{P}}{7{,}400}$$

Where:

L = Allowable leakage in gallons per hour.
N = Number of joints in the length of pipeline tested, or length of pipeline tested (in feet)/typical length per pipe (in feet)
D = Nominal diameter of the pipe, in inches.
P = Average pressure during the leakage test, in pounds per square inch gauge.

C. When making repairs, connections of the approved water main to the existing system, or when specified or determined in the field by the Engineer, all joints, fittings, and portions of pipe lines not able to be tested by conventional methods as specified herein, shall be left exposed and shall be carefully examined for visible leakage while under existing water system line pressure. Those portions of the pipeline covered by backfill shall be observed for leakage appearing on the ground surface. Any leaks discovered in the joints shall be corrected until tight. Any cracked or defective pipe, fittings, etc., discovered in consequence of this pressure test shall be removed and replaced by the Contractor with new material as previously specified and the test repeated until satisfactory to the Engineer.

4.4 DURATION

A. The duration of the pressure test (Test No. 1) shall be a minimum of:
   1. two (2) hours for all push joint Ductile Iron & PVC pipe

B. The duration of the leakage test (Test No. 2) shall be a minimum of:
   1. two (2) hours for all push joint Ductile Iron & PVC pipe

C. The leakage test may be conducted concurrently with the pressure test.

D. Pressure should not fluctuate by more than 5 psi during testing.

4.5 PROCEDURE

A. The pipe shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connections, all necessary apparatus, taps into the pipe, gauges, and measuring devices, will be furnished by the Contractor. All work shall be accomplished by the Contractor.

B. When initial filling/flushing of the new line is achieved by accepting water from an existing water line, the Contractor shall, as a minimum, maintain an open outlet on the new work at all times that the connection between the existing water line and the new work is open. After initial filling/flushing, the Contractor shall, as a minimum, furnish and install a reduced pressure zone (RPZ) backflow preventer at the source of supply to protect against the backflow of water from the new line into the existing line. When water is obtained from existing waterlines for these purposes, the water shall be metered.

C. Testing shall be done as soon as the main line and services are installed.

4.6 EXPELLING AIR BEFORE TESTING

A. Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at various locations and elevations in the test section including the points of highest elevation in the test section. After satisfactory test results, the blow-off tubing and corporation stop shall be removed and replaced with a plug unless the tap will be used for an individual water service connection.

4.7 EXAMINATION UNDER PRESSURE (TEST NO. 1)

A. All exposed pipes, joints and fittings which are exposed when the test is conducted, shall be carefully examined for visible leakage. Those portions of the pipeline covered by backfill shall be walked to observe leakage appearing on the ground surface. Any leaks discovered in the joints shall be corrected until tight. Any cracked or defective pipe, fittings, etc., discovered in consequence of this pressure test shall be removed and replaced by the Contractor with new material as previously specified and the test repeated until satisfactory to the Engineer.

B. If the pressure drop is greater than 5 psi in 2 hours, or if the Engineer believes the line is suspect, the Contractor shall explore for the cause of the excessive leakage and after repairs have been made, the line shall be retested. This procedure shall be repeated until the pressure loss is less than the maximum allowable and the Engineer is satisfied.

4.8 PERMISSIBLE LEAKAGE (TEST NO. 2)

A. Suitable means (acceptable to the Engineer) shall be provided by the Contractor for determining the quantity of water loss by leakage under the specified test pressure. No pipe installation will be acceptable until, or unless, this leakage is less than that specified in this Section, at the test pressure specified.

B. Should any test of pipe laid disclose leakage greater than that specified in this section, the Contractor shall, at his own expense, locate and repair the defective joints or pipe until the leakage is within the specified allowable.

4.9 LEAKAGE DEFINED

A. Leakage is defined as the quantity of water to be supplied into the newly laid pipe necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

4.10 WATER FOR TESTING

A. Water for performing all tests shall be furnished and disposed of by the Contractor, at his expense. If the water for filling and testing is obtained from an existing Town waterline a meter shall be installed to measure the quantity of water used for these purposes. The Contractor is limited to one fill of the line for testing purposes. If the line must be drained for a leak to be repaired, the cost of water used for subsequent fills shall be borne by the Contractor. No water shall be obtained from an existing water line unless the Contractor first obtains the consent of the Owner or agency having jurisdiction over the existing main. Existing conditions may restrict the amount and rate of water that can be obtained from the existing line and the Contractor shall comply with the directions of the Owner or agency of jurisdiction.

B. When filling of the new line is achieved by accepting water from an existing water line, the Contractor shall, as a minimum, furnish and install a reduced pressure zone (RPZ) backflow preventer at the source of the supply to protect against the backflow of water from the new line into the existing line. When water is obtained from existing waterlines for these purposes, the water shall be metered.

PART 5 - DISINFECTION (As per ANSI/AWWA C651-(latest revision))

5.1 ADJUST AND CLEAN

A. Disinfection of Potable Water Systems: All piping connecting to, and forming a part of, a potable water system shall be disinfected in a manner acceptable to the State of Connecticut Department of Health. The method described as follows, or other method acceptable to the Health Department having jurisdiction, shall be used. Water for disinfection and flushing shall be furnished and disposed of by the Contractor.

5.2 CHLORINATION

A. Disinfect the piping system with chlorine applied by introduction of a hypochlorite solution. Calcium hypochlorite in commercial grades contains about 65% to 70% of free chlorine. Hypochlorite powder shall first be made into a paste and then thinned to about 1% chlorine solution. This will require about 7.5 gallons of water to each pound of dry powder. Solutions shall be prepared in wooden or plastic barrel and the solids permitted to settle out. The clear supernatant shall be applied to the main through a rubber hose by a suitable pump feeder.

B. The point of application of the chlorinating agent shall be at the beginning of the piping system or any valved sections thereof, through a corporation inserted in the top of the newly installed pipe. Water from the existing distribution system shall be controlled so as to flow slowly into the newly installed piping system during the application of the chlorine. The rate of chlorine mixture flow shall be in such proportion to the water entering the newly installed pipe that the chlorine dose applied to the new pipe shall produce at least 50 ppm of chlorine residual at the time of application. Valves shall be manipulated so that the strong chlorine solution in the pipe being treated will not flow back into the line supplying the water.

C. The chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24-hour period, the treated water shall contain no less than 25-ppm chlorine throughout the length of the main.

D. When making repairs, connections of the approved water main to the existing system, or when specified, the structures and portions of pipe lines not able to be disinfected by conventional methods, shall be chlorinated by a concentrated chlorine solution containing between 200 ppm (*mg/l*) and 300 ppm (*mg/l*) of free chlorine. The solution shall be applied with a brush or sprayed on the entire inner surface of the empty pipes and structures. The surfaces disinfected shall remain in contact with the strong chlorine solution for at least 30 minutes.

E. The Contractor must use an approved test method to determine chlorine levels. Test strips will be allowed for testing chlorine levels if the kit is new, in the original bottle, and has a color coded scale on the side with legible concentrations defined. Sending samples to an approved laboratory is also acceptable.

5.3 FINAL FLUSHING (As per ANSI/AWWA C655-(latest revision)

A. After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentrated in the water leaving the main is no higher than that generally prevailing in the system, or less than 1 ppm. Chlorine residual determination shall be made at each bacteriological water sampling location to ascertain that the heavily chlorinated water has been removed from the pipeline.

B. Superchlorinated water shall be discharged in a manner that will not adversely effect flora and fauna, and shall conform to all requirements of the State of Connecticut Department of Public Health Drinking Water Section.

PART 6 - BACTERIOLOGICAL TEST (As per ANSI/AWWA C651-(latest revision), Section 5)

6.1 PROCEDURE

A. Sampling:
   1. After completion of final flushing, before the new water main is connected to the distribution system, and in the presence of the Engineer, two (2) sets of bacteriological water samples shall be collected from an acceptable outlet(s) of the treated piping system (one immediately after final flushing and a second one after 24 hours).

B. Testing and Analysis:
   1. All water samples shall be tested to show the presence of a free chlorine residual and the absence of coliform organisms in accordance with the latest State of Connecticut Health Department requirements. A standard heterotrophic plate count or test for HPC bacteria will also be required for each water sample. To pass, test results must reveal total coliform (TC) = 0 and heterotrophic plate count 9HPC) = 0. If, at this time, the samples show unsatisfactory results, the chlorine treatment shall be repeated until all samples show safe results.
   2. Bacteriological testing and analysis must be performed at a laboratory approved by the Health Department and the Owner and shall be paid for by the Contractor. Samples must be picked up by laboratory personnel and delivered to the laboratory. The certified

bacteriological test results must be delivered to the Owner and/or Engineer immediately upon completion.

C. Sampling Locations:

1. The number of bacteriological water samples taken along the full length of pipeline shall be as determined by the Engineer and shall be acceptable to the Health Department having jurisdiction.
2. As a minimum, bacteriological water samples shall be taken as follows:
   a. At a maximum of every 1,200 feet along the new water main.
   b. Within 10 feet of each end of each section of water main
   c. Fire hydrants and hoses are not considered acceptable sampling ports.
3. The Contractor shall, at his expense, provide all necessary taps (wet or dry), outlets, fittings, piping, apparatus, labor, materials, equipment, water, etc. required. There is no water source on site for testing. Contractor will need to supply all water for testing and disinfection purposes.

END OF SECTION 331000

SECTION 333000 - SANITARY SEWER SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to work specified in this section.

1.2 DESCRIPTION OF WORK

A. Extent of sewer collection system work is shown on Drawings. Sewer collection system work includes, but is not limited to, the following:
   1. Pipe Laying
   2. Manholes
   3. Services
   4. Casings
   5. Restoration
   6. Testing

B. Comply with requirements of applicable Division-31 sections for excavation and backfilling required in connection with sanitary sewer system.

C. Comply with requirements of applicable Division-3 sections for concrete work required in connection with sanitary sewer system.

1.3 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data Submit a minimum of six (6) shop Drawings from each manufacturer of materials to be incorporated in the construction of sanitary sewer system that material meets Specifications of this section.

1.4 NOTIFICATIONS

A. Notify the Architect / Engineer of the starting date of sanitary sewer system construction, in writing, five (5) days in advance of construction to arrange for stakeout of the work.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture and installation of sanitary sewage system's products of types, materials, and sizes required, whose products have been satisfactory use in similar service for not less than 5 years.

PART 2 - MATERIALS

2.1 POLYVINYL CHLORIDE (PVC) NON PRESSURE PIPE (SMALL DIAMETER)

A. PVC pipe 8-inch through 15-inch nominal diameter shall be manufactured from Class 12454-B PVC compound conforming to ASTM Specification D 1784. Pipe and fittings shall meet and/or exceed all of the requirements of ASTM Specification D 3034 with a minimum SDR of 35 and pipe stiffness of 46 psi.

1. The sewer pipe shall have elastomeric gasket joints conforming to ASTM F477 and shall be furnished in thirteen (13) or twenty (20) foot standard lengths.
2. All fittings and accessories shall be as manufactured and furnished by the pipe supplier or approved equal and have a joint configuration identical to that of the pipe.

2.2 POLYVINYL CHLORIDE (PVC) NON PRESSURE (LARGE DIAMETER)

A. PVC pipe 18-inch through 27-inch nominal diameter shall be manufactured from class 12364C or 12454C PVC compound conforming to ASTM Specification D1784. Pipe and fitting shall meet and/or exceed all of the requirements of ASTM Specification F679 with a minimum SDR of 35 and pipe stiffness of 46 psi.

1. The sewer pipe shall have a rubber gasket and be in compliance with Specification F477 and shall be furnished in twelve and one half ft. (12-1/2) standard lengths.
2. All fittings and accessories shall be as manufactured and furnished by the pipe supplier or approved equal and have a joint configuration identical to that of the pipe.

2.3 DUCTILE-IRON PIPE (D.I.P.) SEWER FORCEMAIN

A. Ductile-Iron pipe in sizes three inches (3”) to twenty-four inches (24”) in diameter inclusive will be centrifugally cast conforming with the applicable requirements of the AWWA Standards for Ductile-Iron Pipe, Centrifugally Cast for Water, ANSI/AWWA C151/A21.51 –(latest revision), as manufactured by:

1. U.S. Pipe Co.
2. Griffin Pipe
3. American Pipe

B. Ductile –Iron pipe shall be Class 50 unless otherwise specified on the plans.

C. Mechanical and push-on joints for ductile-iron pipe shall conform to the AWWA Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings. ANSI/AWWA C111/A21.11-(latest revision).

D. All Ductile-Iron pipe shall be double thickness cement lined in accordance with the requirements of the AWWA Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water. ANSI/AWWA C104/A21.4 – (latest revision).

2.4 POLYVINYL CHLORIDE (PVC) SEWER FORCE MAIN PRESSURE PIPE

A. Shall conform to ASTM D2241 PVC plastic pipe and ASTM D1784 rigid PVC compound.

1. The PVC pipe 3” in diameter and smaller shall have a standard thermoplastic pipe dimension ratio (SDR) of 21 and pressure class of 200 psi.
2. The PVC pipe 4” in diameter and larger for direct bury installation shall have a standard thermoplastic pipe dimension ratio (SDR) of 26 and pressure class of 150 psi.

B. Thrust blocks and/or mechanical restraints will be provided where fittings are used for direction changes as shown on the plans and details, and wherever specified by the Engineer.

C. The sewer force main joints for direct bury PVC piping shall have rubber ring (integral bell) and the pipe shall be furnished in twenty (20) foot standard lengths.

D. Magnetic Tape Market for laying directly over the PVC pressure pipe shall be three inches (3”) wide, colored greed and be as manufactured by:
1. Reef Industries, Inc.
2. C.H. Hanson Products
3. Paul Potter Warning Tapes, Inc.

2.5 PRESSURE FITTINGS

A. Fittings for polyvinyl chloride pressure pipes less than four inches (4”) in diameter shall be 200 psi pressure rated PVC with bell and spigot type joints with rubber gaskets or schedule 80 solvent weld joints conforming to ASTM D2467.

B. Fittings for ductile iron & polyvinyl chloride pressure pipes four inches (4”) to twenty-four inches (24”) and polyethylene pressure pipes six inches (6”) to twenty-four inches (24”) in diameter shall be Class 350 ductile iron and conform to the AWWA Standard for Ductile-Iron Compact Fittings for Water Service, ANSI/AWWA C153/A21.53-(latest revision) as manufactured by:
1. Tyler Pipe Co.
2. U.S. Pipe Co.
3. American Pipe

C. All ductile-iron fittings shall be double thickness cement lined in accordance with the requirements of the AWWA Standard for Cement - Mortar Lining for Ductile-Iron Pipe and Fittings for Water, ANSI/AWWA C104/A21.4- (latest revision).

D. All ductile iron fittings shall have mechanical joint ends and be furnished with sufficient quantities of accessories. All nuts and tee bolts for fittings shall be Cor-Ten and shall conform to AWWA C-111/A21.11-(latest revision). Restrained joints will be required.

E. Additional restraint and internal joint stiffeners will be required for all mechanical joints, push joints, and bolted couplings used on polyethylene pressure pipe.

2.6 PRE-CAST CONCRETE SANITARY SEWER MANHOLES

A. Manhole assemblies shall conform to the latest requirements of ASTM Designation C-478.

B. Joints shall consist of a round rubber gasket conforming to ASTM 443 snapped into a groove in accurately sized and shaped spigot ring. The rubber gasket shall be compressed between the spigot and bell rings when the manhole sections are assembled the entire joint shall then be mortared all around.

C. Mechanical pipe-to-wall seals, (rubber boot, rubber ring/wedge). Manufacturers:
   1. Link-Seal
   2. Metroflex
   3. General Engineering

2.7 MANHOLE FRAMES AND COVER

A. Shall be manufactured of close grained gray iron conforming to the requirements of ASTM Designation A-48 Class 35B and meet HS-25 loading requirements.

B. All castings shall be true to pattern in form and dimensions, free from faults, sponginess, cracks, blowholes and other defects affecting their strength. Cover and seating rings shall be machined to insure even uniform bearing all around. Covers shall be drilled and lettered as shown on the drawings.

C. Locking devices may be required on manhole covers only as identified and detailed on the drawings or as determined in the field by the Engineer.

D. Watertight frames and covers may be required only as identified and detailed on the drawings or as determined in the field by the Engineer. Covers shall be solid with non-penetrating pickholes, and shall be lettered to match standard manhole covers.

2.8 PROTECTIVE COATINGS

A. All bare surfaces shall be coated with:
   1. Koppers Bitumastic No. 505,
   2. Midland Asphalt “RC-30” Bitumen Black,
   3. Carboline

B. Manholes and concrete chambers shall be coated by the manufacturer on the entire outside and inside area with bitumastic coating.

2.9 SERVICE ITEMS FOR NON-PRESSURE SEWER

A. Branch Connections
   1. Tee-Wyes and bends shall conform to the type of pipe which is furnished for the sewer main.

B. Riser Pipe
   1. A riser pipe shall be used to bring the branch connections up to the required depth as shown on the plan or as otherwise determined in the field by the Engineer.
   2. Riser and fittings shall conform to the type of pipe which is furnished for the sewer main and service lateral.

3. The trench shall be backfilled with No. 1 and No. 2 stone to a depth of 6 inches above the riser and four feet either side of the wye or riser along the mainline trench as shown or noted on the detail.

C. Service Lateral

1. Shall conform to the type of pipe which is furnished for the sewer main. The service lateral shall be installed according to the detail. It shall consist of a 4-inch diameter sewer pipe laid to a minimum grade of 1/8-inch per foot.
2. Service laterals that cross roads which cannot be disturbed shall be installed in a suitable steel encasement pipe installed by boring. The encasement pipe and the lateral pipe within shall be paid under their respective items of casing pipe and service lateral.

D. Running Trap and Vent

1. The trap and vent shall meet the requirements of ASTM A74 and be acceptable to the Engineer.
2. The joints shall be sealed with a positive double-seal elastometric compression type gaskets conforming to ASTM Specification C564 or latest revision thereof.
3. The vent pipe shall be 4-inch diameter PVC plastic conforming to the requirements of material Specification for PVC gravity sewer pipe.
4. A Calder coupling or equivalent shall be used at the highway boundary to adapt from the service lateral material as bid to the spigot end of the trap.
5. The “A” Clamp by LNR Industries shall be used to secure the connection between the trap and vent pipe. Contractor will supply The “A” Clamp that will be compatible with the 4-inch diameter cast iron trap spigot and the 4-inch diameter PVC-SDR-35 vent pipe. Threaded rod or 3/8-inch bolts will then be used to connect The “A” Clamp and hold the joint firmly.

2.11 SERVICE ITEMS FOR PRESSURE SEWER

A. Service Lateral

1. Shall be polyethylene water service tubing Class 200 (SDR-9) conforming to ASTM D-2737 all necessary connections shall be of type specifically designed for copper tube size (CTS) polyethylene.

B. Curb Valves

1. Shall be full port ball valves, quarter turn check, of all brass construction and in the size indicated on the plans. As manufactured by:
   a. Mueller Model 300B-20283
   b. Ford
   c. AY McDonald

C. Curb Boxes

1. Shall be screw type adjustable, 2 ½” shaft, size 93E or 95E for 1 ½” and 2” curb valves with adaptor base.
2. Each curb box shall be supplied with a rod and guide ring, unless otherwise noted or determined in the field by the Owner and/or Engineer, and have the word “SEWER” cast on the lid.

E. Redundant Check Valves
   1. Shall be full swing check valves, 125 WSP rating, of all brass construction and in the size indicated on the plans and/or details.

2.12 SEWAGE CONTROL VALVES

A. Valves shall be of the plug, ball or resilient wedge type and be full port with semi-steel ductile iron or cast iron body.

B. Valves shall be non-lubricated, the plug or disk shall have a stainless steel face or resilient rubber material face.

C. Interior connections shall be flanged and drilled to American standard templates for 125 pound flanges and have the following type of operators:

D. Overhead - chain wheel
   1. Under walkway - operator stand with hand wheel
   2. Accessible - 2-inch square nut and multi-position wrench or hand wheel.

E. Buried connection shall have mechanical or slip type joints and have the following type of operator, 2-inch square nut with cast iron valve box, extension stem to one foot below grade and valve key, four foot long.

F. An indication of position of the valve shall be provided when specifically shown on the Plans.

2.13 FORCE MAIN CLEAN OUT

A. PVC sewer pipe and fittings shall conform to the requirements as described in the material section of the specification.

B. Cleanout chamber shall be NDS Pro Series 14” x 19” Rectangular Valve Box with 6” extension and overlapping, bolt-down cover with the word “SEWER” cast on top, as manufactured by:
   1. NDS, Inc.
   2. DFW Plastics, Inc.
   3. Drain-Tech

C. Adjustable valve boxes shall be two piece screw type, 4½” shaft roadway box, the cover of which shall have cast thereon the word “SEWER”.

D. Sewage valves shall be full port ball valves, quarter turn check, of all brass construction and in the size as shown on the plans.

2.14 ANCHORAGES

A. General: Provide anchorages for tees, plugs, caps, bends, valves, couplings and pipe as shown on the plans and as follows:
   1. Joints: Cor-ten nuts and bolts conforming to ANSI/AWWA C-111/A21.11- (latest revision).
   2. Thrust Blocks: 3000 psi concrete.

B. Retainer glands for ductile iron pipe to fit mechanical joints shall be:
   1. wedge action EBAA Iron Series 1100
   2. Uni-Flange Series 1400
   3. Smith Blair

C. Retainer glands for PVC pipe to fit mechanical joints shall be:
   1. EBAA Iron Series 2000 PV
   2. Uni-Flange Series 1500
   3. Smith Blair

D. Restraint harnesses for push joint ductile iron pipe shall be:
   1. wedge action EBAA Iron Series 1700 Megalug
   2. Uni-Flange Series 1450
   3. Smith Blair

E. Restraint harnesses for push joint PVC shall be:
   1. EBAA Iron Series 1600
   2. Uni-Flange Series 1350
   3. Smith Blair

F. Restraint harnesses for cast iron pipe joints shall be of the friction clamp type with threaded rods.

2.15 PRECAST CONCRETE

A. The Contractor shall provide all materials, labor, equipment, supervision and incidentals required to furnish and install the concrete structures shown on the Drawings and specified herein.

B. The Contractor shall coordinate installation of structures with installation of adjacent pipe, valves and items that must be installed in the concrete in a manner acceptable to the Architect / Engineer.

C. Depth, width and length shall be as shown on the Plans.

D. Chambers, frames and covers shall be designed for HS-25 loads and any additional indicated loads.

E. All precast structures shall conform to the requirements of concrete work, see Section 033100.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Manholes shall be installed in accordance with the manufacturer's instructions and as shown on the Plans.

B. Polyvinyl Chloride Non-Pressure Pipe and Pressure Pipe: Install in accordance with manufacturer's instructions and as shown on the Plans.

C. Ductile Iron Pressure Pipe: Install in accordance with manufacturing instructions and as shown on the Plans.

D. Control Valves: Install in accordance with manufacturer's instructions and as shown on the Plans.

E. Interior Examination: Examine conduit to determine whether line displacement or other damage has occurred.

F. If the examination indicates poor alignment, debris, displaced pipe, infiltration or other defects, correct such defects at no direct cost to the Owner.

G. Place plugs in end of uncompleted conduit at end of day or whenever work stops.

H. Backfilling: Conduct backfilling operations of open-cut trenches closely following laying, jointing and bedding of pipe, and after initial inspection and testing are complete.

PART 4 - TESTING - PRESSURE & LEAKAGE

4.1 Perform low pressure air test, exfiltration test, infiltration and hydrostatic test, and vacuum test for manholes in accordance with the following:

A. Test No. 1 - Low Pressure Air Test
   1. The air test shall be four (4) psi gauge; groundwater must be below invert of sewer line under test.

B. Test No. 2 - Exfiltration Testing
   1. An exfiltration test shall be done on all section of the contract in which the groundwater is less than two feet above the crown of the pipe measured at the highest elevation.
   2. If an acceptable air test has been performed, the Contractor may be required to also do an exfiltration test on a minimum of three sections per contract and two sections each size and each type of pipe. This shall be done within 48 hours following an acceptable air test.

C. Test No. 3 - Infiltration Observations
   1. Infiltration test shall be done on all sections of the contract in which the groundwater is at least two feet above the crown of the pipe for the entire length of the section being tested. This shall be done in a timely manner after the constructing of the system. The Owner or the Owner's representative may make observation at any time prior to the end of the guarantee period.
   2. The maximum allowable infiltration rate for the sewer main will be 100 gallons per inch of inside pipe diameter per mile of sewer per 24 hours.

D. Test No. 4 - Testing of Manholes
   1. Manholes cannot be properly air tested. Therefore they should be visually inspected and leakage tested using either internal/external hydrostatic pressure or vacuum.

E. Test No. 5 - Pressure Test - Force Main

1. The hydrostatic pressure shall be 100 pounds per square inch, based on the elevation of the lowest point in the line or section under test and corrected to the elevation of the test gauge.

F. Test No. 6 - Leakage Test - Force Main
1. The hydrostatic pressure shall be 100 pounds per square inch, based on the elevation of the lowest point in the line or section under test and corrected to the elevation of the test gauge.
2. The leakage under the conditions of the test for force main shall be determined by the following formula:

$$L = \frac{ND\sqrt{P}}{7400}$$

where:
L = Allowable leakage in gallons per hour
N = Number of joints in the length of pipeline tested
D = Nominal diameter of pipe in inches
P = Average pressure during the leakage test, in pounds per square inch gauge

4.2 DURATION

A. The duration of the various tests shall be:
1. Test No. 1 - Low-pressure air test for sanitary sewers will vary depending on the size of the sewer pipe, and after desired pressure has stabilized for a minimum of two minutes.
2. Test No. 2 - Exfiltration testing for sanitary sewers will be the maximum allowable drop-in level in 15 minute per 100 feet of various sewer main size.
3. Test No. 3 - Infiltration observation for sanitary sewers and manholes - any time within the guarantee period.
4. Test No. 4A - Infiltration/exfiltration test of manholes minimum two (2) hours.
5. Test No. 4B - Vacuum test of manholes
   a. The time required for a vacuum test shall be what it takes for 10-inch of mercury to drop to 9-inch, as per the following table:

Manhole Depth	Diameter	Time to Drop 1’ Hg.
10 ft. or less	4 ft.	60 seconds
10 ft. to 15 ft.	4 ft.	75 seconds
15 ft. to 25 ft.	4 ft.	90 seconds

   b. For a manhole of five ft. in diameter add an additional 15 seconds and for six ft. diameter add an additional 30 seconds to the time required for a four foot diameter manhole.
6. Test No. 5 - Pressure test force main minimum one (1) hour.
7. Test No. 6 - Leakage test - force main minimum of two (2) hours.

4.3 PROCEDURE

A. Preparation for Testing

1. Prior to commencing the air test the sewer main shall be subject to an alignment test and a deflection test. The alignment test shall be conducted by the Architect / Engineer or his authorized representative by flashing a light between manholes. The deflection test shall be performed by the Contractor and witnessed by the Architect / Engineer or his authorized representative. The Contractor shall manually pull through each section of pipe a pin-type vertical gage mounted on a sled or a rigid ball. The gage and/or rigid ball shall be set so that if vertical deflection of pipe exceeds five percent it will stop.

2. When the alignment test and deflection test have been completed, the sewer main shall be cleaned by flushing a snug-fitting ball between manholes. Pipes which are not satisfactorily aligned or exceed the allowable deflection, will be repaired and cleaned at the Contractor's expense. The alignment test, deflection test and cleaning will be continued until meeting this specification. Concrete bench walls will not be permitted to be poured until after the sewer has been cleansed, the manhole bottoms will be used to collect any mud, stones or debris, preventing same from entering sewer system.

B. Test No. 1 - Low Pressure Air Test of Sanitary Sewers

1. The Contractor shall determine the depth of the groundwater to ensure that it is below the invert of the sewer line, prior to performing a low-pressure air test. If the groundwater is not below the invert a low pressure air test will not be an acceptable test and the Contractor shall either do an exfiltration or an infiltration test depending upon groundwater depth.

2. The Contractor shall then perform the air test by placing airtight plugs in the ends of all openings of the section of sewer being tested and adding air slowly to this section until the pressure reaches four (4) psi. This pressure must be maintained for two minutes. If the pressure is not maintained, the sewer main and connection shall be carefully inspected for leaks and repaired before test proceeds. Once the test starts a stopwatch shall be used for the exact time which is required for the pressure to drop 0.5 psi. The minimum time allowed is shown in the accompanying chart.

Pipe Diameter (inches)	Minimum Time Allowed for 0.5 psig Pressure Drop (minutes)
up to 4	8
6	12
8	16
10	20
12	24
14	28
15	30
16	32
18	36
21	42
24	48
27	54
30	60

3. In the event the time required to drop 0.5-psi gauge exceeds the chart value for the size pipe under test, it shall be considered acceptable.
4. In the event the time required for the specified pressure drop is less than the chart value, the test shall be considered unacceptable. Unacceptable sections shall be carefully inspected for defects, misplaced joints, cracked or broken pipes or any other defects, all which shall be repaired or replaced at the expense of the Contractor. After this work has been completed, the test shall be repeated.

C. Test No. 2 - Exfiltration Testing of Sanitary Sewers
1. Exfiltration testing of the respective pipeline sections and manholes shall be done when the groundwater level is less than two feet above the crown of the pipe.
2. For the exfiltration test, the test head at the upstream manhole must be established a minimum of two feet above the crown of the pipe or at least two feet above existing groundwater, whichever is higher. The section to be tested shall be filled with water at least four hours prior to testing. Plugs shall be inserted in the pipe at each manhole, and provide a 1-inch riser pipe on the upper plug projected to the manhole rim, or a minimum of 11.5 feet above the elevation of the sewer invert at the center of the section to be tested. At the top of the 1-inch riser pipe, the Contractor shall provide a 6-inch diameter chamber 24 inches high, with 1/2-inch inside diameter clear plastic tubing on the exterior to observe and measure the drop on water level.
3. Maximum allowable drop in level in 15 minutes per 100 feet of the various sewer main sizes to be as follows:

SIZE	DROP	SIZE	DROP
8”	1.3”	21”	3.4”
10”	1.6”	24”	3.9”
12”	2.0”	27”	4.4”
15”	2.4”	30”	4.9”
18”	2.9”		

4. In the event that any section of sewer main is unacceptable, because of repeated failure to pass the required exfiltration test, the Contractor will be required to have it inspected by means of closed circuit television or other customary camera system at his own expense. Permanent videotape or film to be furnished to the Owner. The Contractor shall, without expense to the Owner, repair all defects disclosed by the inspection of the sewer main.
5. Final acceptance of the lines shall not be made until all required tests and inspections have been completed.

D. Test No. 3 - Infiltration Observations of Sanitary Sewers
1. Infiltration test shall be done on all sections of the Contract in which the groundwater is at least two feet above the crown of the pipe, for the entire length of the section being tested.
2. Infiltration observations will be made by the Owner or Owner’s Representative at any time prior to the end of the guarantee period. Watertight manholes are required without infiltration, maximum allowable infiltration rate for the sewer mains will be 100 gallons per inch of inside pipe diameter per mile of sewer per 24 hours. The Contractor shall, at his own expense, locate and repair any and/or all leaks in the sewer main and appurtenances.
3. In the event that any section of sewer main is unacceptable, because of repeated failure to pass the required tests or infiltration in excess of the amount allowed, the Contractor will be required to have it inspected by means of closed circuit television or other customary

camera system at his own expense. Permanent videotape or film to be furnished to the Owner. The Contractor shall, without expense to the Owner, repair all defects disclosed by this inspection of the sewer main.

4. Final acceptance of the lines shall not be made until all required tests have been completed.

E. Test No. 4A - Infiltration/Exfiltration Testing of Manholes

1. Infiltration testing shall be performed on all manholes in which the groundwater is at least two feet above the highest joint in the manhole being tested.
2. Infiltration observations will be made by the Owner or Owner's Representative at any time prior to the end of the guarantee period. Measured infiltration shall not exceed the maximum allowable infiltration rate for manholes. The maximum allowable infiltration rate for manholes will be 100 gallons per inch of inside diameter per mile of manhole depth per 24 hours. The Contractor shall, at his own expense, locate and repair any and/or all leaks in the manholes.
3. Exfiltration testing shall be performed on all manholes in which the groundwater level is less than two feet above the highest joint in the manhole.
4. For the manhole exfiltration test, the test head must be established at least two feet above the highest joint in the manhole or two feet above the groundwater level, whichever is higher. The manhole to be tested shall be filled with water at least four hours prior to testing. Plugs shall be inserted in each pipe entering and leaving the manhole and properly secured to avoid displacement. The exfiltration test shall be conducted for a minimum of two hours with a maximum allowable leakage not to exceed 100 gallons per inch of inside manhole diameter per mile of manhole depth per 24 hours. The drop in water elevation shall be accurately measured to calculate the actual leakage.
5. All manholes which exceed the allowable leakage rates specified above shall be repaired and retested at no expense to the Owner until such time that the actual measured leakage is less than the calculated allowable leakage.

F. Test No. 4B - Vacuum Testing of Manholes

1. This type of test is only applicable to precast concrete manholes. All lifting holes and exterior joints shall be filled and pointed with non-shrinking mortar.
2. The manhole shall be tested immediately after assembly and prior to backfilling and the excavated area shall be free of standing water.
3. All pipes and other openings into the manhole shall be suitably plugged and in such a manner as to prevent movement while the vacuum is drawn.
4. Installation and operation of vacuum equipment and indicating devices shall be in accordance with the manufacturer's recommendations.
5. If the manhole fails the test the Contractor shall make the necessary repairs and retest until a satisfactory test is obtained.

G. Test No. 5 - Pressure Test Force Main

1. The mains will be tested section by section with the use of valves in the lines, but the Owner reserves the right to test any or all sections at any time. The Contractor shall furnish all water necessary to place the lines in service, as determined by meter readings or the Architect / Engineer's estimate if no meter readings are available. Water source shall be from a source acceptable to the Owner or Agency with proper jurisdiction. The Contractor shall furnish all labor and equipment necessary to perform and carry out the test. The section of force main to be tested shall be filled with water.

H. Test No. 6 - Leakage Test Force Main

1. A leakage test shall be conducted after the pressure test has been satisfactorily completed. The Contractor shall furnish all labor and equipment necessary to perform the leakage test. The section of line to be tested shall be filled with water and pumped up to the test pressure. The line shall be maintained under this test pressure for the duration of the test by pumping water into the lines at frequent intervals. The volume of water so added shall be measured and considered to represent the leakage from the line under test during the interval.

4.4 EXPELLING AIR BEFORE TESTING WHEN APPLICABLE

A. Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this taps shall be made, if necessary, at various locations and elevations in the test section including the points of highest elevation in the test section. After satisfactory test results these taps shall be tightly closed and copper tube removed.

4.5 EXAMINATION UNDER PRESSURE

A. All exposed pipes, joints and fittings which are exposed when the test is conducted shall be carefully examined for visible leakage. Those portions of the pipeline covered by backfill shall be walked to observe leakage appearing on the ground surface. Any leaks discovered in the joints shall be corrected until tight. Any cracked or defective pipe, fittings, etc., discovered in consequence of this pressure test shall be removed and replaced by the Contractor with new material as previously specified and the test repeated until meeting the specifications.

4.6 PERMISSIBLE LEAKAGE

A. Reasonable and customary means shall be provided by the Contractor for determining the quantity of air or water loss by leakage under the specified test pressure. No pipe installation will be acceptable until, or unless, this leakage is less than that specified in this Section, at the test pressure specified.

B. Should any test of pipe laid disclose leakage greater than that specified in this Section, the Contractor shall, at his own expense, locate and repair the defective joints or pipe until the leakage is within the specified allowable.

4.7 LEAKAGE DEFINED

A. Leakage is defined as the quantity of air or water to be supplied into the newly laid pipe necessary to maintain the specified leakage test pressure after the pipe has been filled with air or water.

4.8 WATER FOR TESTING

A. Water for performing all tests shall be furnished, brought on site and properly disposed of by the Contractor, at his expense. There is no water available from an existing waterline.

B. Air for Testing: The Contractor shall provide an air compressor, air hose, fittings, gauges and other equipment necessary to perform the required air test.

END OF SECTION 333000

SECTION 333213.13A.4 ABOVE GRADE WET WELL MOUNTED QUAD-PLEX PUMP STATION PUMP STATION NO. 2

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division –1 Specifications, apply to work specified in this section.

1.2 DESCRIPTION OF WORK:

A. Extent of Above Grade Wet Well Mounted Pump Station work is shown on the drawings and described herein or as otherwise necessary for a complete installation at Pump Station No. 2. The work includes but is not limited to the following:

1. Above Grade Wet Well Mounted Pump Station including pumps, motors and associated equipment
2. Wet well chamber
3. Submersible transducer based level control system and redundant float based control system
4. Allen Bradley control system fully compatible with existing Town SCADA system.
5. Control panel with motor starting equipment
6. New outdoor diesel generator and enclosure.
7. Electrical work (All wiring and including that from control panel to the power supply, including pump station enclosure.
8. Gravity Sewer, Force Main piping, and accessories associated with pump station.
9. Excavation, Dewatering, Backfill, Fill Material, and compaction.
10. Water service
11. Pig Launcher
12. Testing
13. Concrete work
14. Landscaping, Restoration, and other site work

B. The pump station shall be as manufactured by Smith & Loveless, Inc. and shall conform to the manufacturer's published specifications and the requirements of the Engineer. These specifications are based on the Smith & Loveless, Inc. and are not intended to be restrictive but to convey the intent and performance of the pump station equipment. The station shall be complete with all needed equipment, factory-installed on a welded steel base with fiberglass cover. The principal items of equipment shall include four vertical, closed coupled, motor driven, vacuum primed, X-pellar Super Clog Resistant mono-port impeller; valves; internal piping; central control panel with circuit breakers; motor starters and automatic pumping level controls; heater; ventilating blower; priming pumps and appurtenances; and all internal wiring.

C. The Contractor shall furnish, install and coordinate telephone and power services for the pump station and appurtenances.

D. Connecticut Power and Light services power to the pump station site. The Contractor must coordinate with Connecticut Power and Light on all power service issues.

1.3 ACTION SUBMITTALS:

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS.

B. Product Data: Submit a minimum of six (6) shop drawings from each manufacturer of materials and equipment to be incorporated in the construction of the above grade wet well mounted quad-plex pump station.

C. Maintenance Data: For Wet Well Mounted Pump Station – Pump Station No. 2 to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

1.4 NOTIFICATIONS:

A. Notify the Engineer of the starting date of wet well mounted pumping station construction, in writing, five (5) days in advance of construction.

1.5 GENERAL:

A. Provide manufacturer's standard packaged, pre-engineered, pre-fabricated units with selections as indicated to comply with requirements; and with components of each unit complying with manufacturer's published product literature, and as required for a complete operable system.

1.6 ANTI-FLOTATION:

A. The Contractor shall supply appropriate anti-flotation calculations for the proposed chamber and shall not take credit for weight of equipment in the chamber or for external soil load. Also, the water table shall be assumed to be at the ground surface. The anti-flotation calculations shall be signed and sealed by a Connecticut State licensed Professional Engineer and be submitted with the shop drawings for review by the Engineer.

B. If concrete is used for anti-flotation, the concrete mass shall be reinforced and proposed attachment to the chamber shall be submitted with the anti-flotation calculation.

C. Comply with requirements of applicable Section 300000 – Form 816 Site Work for excavation and backfilling required in connection with Pump Station No. 2.

D. Comply with requirements of applicable Division 3 Sections for concrete work required in connection with sanitary sewer system.

1.7 PROTECT FROM DAMAGE:

A. From the time the pump station is delivered until final acceptance of the completed pump station, the Contractor shall protect the pump station from any and all damage including flooding or freezing. The Contractor shall make periodic inspections of the pump station to check for any possible problems including flooding or equipment failure. In the event of damage due to Contractor failing to maintain the pump station as outlined above, all expenses necessary to restore the pump station to an acceptable condition as determined by the Owner, shall be borne by the Contractor.

PART 2 - MATERIALS

2.1 PRE-PACKAGED PUMP STATION:

A. The station shall be constructed in one complete factory-built assembly. It shall be sized to rest on top of the wet well as detailed in the construction drawings. The station shell shall be ¼” and the supporting floor plate shall be minimum 3/8" thick steel with reinforcing, as required, to prevent deflection and insure an absolutely rigid support.

B. The pump station shall be enclosed by a hinged fiberglass cover(s). The cover(s) shall have a suitable drip-lip around the edge and shall be provided with a hasp and staple connection to the floor plate to allow the pump chamber to be locked with a padlock. The cover(s) shall have a latch mechanism to keep the cover(s) open under load. Adjustable ventilating louvers shall be provided on each end of the fiberglass cover(s) which are capable of being closed during cold weather operation.

C. An aluminum manway cover, located exterior to the fiberglass pump chamber, shall be provided, complete with padlocking provisions. The manway shall be an integral part of the station floor plate and provide access to the wet well.

D. A stanchion with lifting arm shall be provided to lift each pump. The lifting arm shall have a hook over the center of the motor to support a hoist for removal of the motors, impellers and pumps from the station.

2.2 PUMP CONSTRUCTION:

A. Four pumps shall be provided for the pump station. The pumps shall be vertical, non-clog two-port impeller type of heavy cast iron construction, especially designed for the use of mechanical seals and vacuum priming. In order to minimize seal wear caused by linear movement of the shaft, the shaft bearing nearest the pump impeller shall be locked in place so that end play is limited to the clearance within the bearing. To minimize seal wear resulting from shaft deflection caused by the radial thrust of the pump, the shaft from the top of the impeller to the lower bearing supporting the impeller shall have a minimum diameter of 1-7/8” for motor frame sizes 213 through 286; 2-1/8” for motor frame sizes 324 and 326; and 3” for frame 364 and larger. The dimension from the lowest bearing to the top of the impeller shall not exceed 6”.

B. The bearing nearest the impeller shall be designed for the combined thrust and radial load. The upper bearing shall be free to move in a linear direction with the thermal expansion of the shaft and shall carry only radial loads.

C. The shaft shall be solid stainless steel through the mechanical seal to eliminate corrosion and abrasive rust particles. Removable shaft sleeves will not be acceptable if the shaft under the sleeve does not meet the specified minimum diameter.

D. The impeller port shall have a minimum area of 10.6 in^2, and shall be keyed with a stainless steel key and secured to the motor shaft by stainless steel cap screw equipped with a Nylock or other self-locking device. The impeller shall not be pinned or screwed to the motor pump and shall be removable without the use of special tools. All impellers less than full diameter shall be trimmed inside the impeller shrouds. The shrouds shall remain full in diameter so that close minimum clearance from shrouds to volute is maintained. Both the end of the shaft and the bore of the impeller shall be tapered to permit easy removal of the impeller from the shaft. The impeller shall be Smith & Loveless X-Peller type impeller.

E. The pump shall have an adapter providing a large water reservoir above the impeller to provide for positive exclusion of air from the impeller. The seal shall be inside this area to assure lubrication. Pumps which do not use hollow priming adapter for positive lubrication of the seal will not be acceptable.

F. The pump shall be constructed so as to permit priming from the lower pressure area behind the impeller. Priming from high pressure connections, causing solids to enter and clog the priming system, will not be acceptable. The priming bowl shall be transparent, enabling the operator to monitor the priming level.

G. The pump shall be arranged so that the rotating element can easily be removed from the casing without disconnecting the electrical wiring or disassembling the motor, impeller, backhead or seal, so that any foreign object may be removed from the pump or suction line.

H. The pump shaft shall be sealed against leakage by a single mechanical seal constructed so as to be automatically drained and primed each time the pump is drained and primed. Water which lubricates the mechanical seal shall be automatically drained from around the seal if the pump loses prime in order to allow both, the pump and the seal to be drained, thereby preventing freezing and breakage of the seal during power outages in sub-freezing temperatures.

I. The seal shall be of carbon and ceramic materials with the mating surfaces lapped to a flatness tolerance of one light band. The rotating ceramic shall be held in mating position with the stationary carbon by a stainless steel spring.

J. The pump volute shall be furnished with mounting lugs and bolted to the station floor plate, forming a gas-tight seal.

K. Motors
   1. Four (4) motors manufactured by manufactured by the pump supplier shall be supplied for Pump Station No. 2. The motors shall include thrust bearings.
   2. The pump motors shall be guaranteed to run continuously without damage. Motors shall be vertical, solid shaft, NEMA P-base, squirrel-cage induction type. They shall be open, drip-proof design with forced air circulation by integral fan. Openings for ventilation shall be

uniformly spaced around the motor frame. Motors shall be 480V, (60Hz), three (3) phase, 3 wire with ground construction.

3. The motor shall be fitted with heavy lifting eyes or lugs, each capable of supporting the entire weight of the pump and motor.
4. Motor sizes for Pump Station No. 2 are listed on the plans in the equipment list shown on the plan sheet.

2.3 MAIN PIPING

A. The pump suction shall be drilled and tapped for a 125 pound American Standard flange for ready connection of the suction riser. The discharge line from each pump shall be fitted with a clapper-type check valve and eccentric plug valve. Size, location, and quantity of check valves and plug valves shall be as shown on the plans.

B. The check valve shall be of the spring-loaded type with external lever arm and an easily replaced resilient seat for added assurance against vacuum leaks. Check valves shall have stainless steel shaft with replaceable bronze shaft bushings and shall be sealed with an adjustable Teflon seal. An operating wrench shall be provided for the plug valves.

C. Protrusions through the floor plate shall be gas-tight where necessary to effect sealing between the equipment chamber and the wet well. Bolted and sealed joints shall be provided at the pump casing or suction pipes in order to prevent corrosive, noxious fumes from entering the station. The pump station manufacturer shall extend the suction and discharge connections below the floor plate at the factory so that field connections can be made without disturbing the gas tight seals.

D. The manufacturer of the pump station shall provide a compression-type sleeve coupling for installation of the common discharge pipe.

E. Suction and discharge connections shall be ANSI B16.1 125 lb, flat face flanges. Interior station piping shall be polyvinylchloride (PVC), Sch. 80 with bolted fittings.

F. Suction pipe support brackets shall be furnished and installed as necessary as shown or noted on the plans or as otherwise determined.

G. Compound Pressure gauge on pump discharge (0-30 psi) shall be provided with bronze hardware with 1/4" NPT taps and corporation stop, pressure rated for this application.

2.4 PUMP CONTROL PANEL

A. The control equipment shall be mounted in a NEMA Type 1 steel enclosure with a removable access cover. The circuit breakers, starter reset buttons, and control switches shall be operable without removing the access cover, for deadfront operation.

B. The pump control panel shall include one (1) three-position, hand-off-auto selector switch and one (1) start button and one (1) stop button for each pump. When the selector switch is in “auto” position and the automatic control system annunciates that a pump is required, a pump shall be called to start. When the selector switch is in the “hand” position, the start-stop buttons shall be the means to start or stop the pump. A hard wire shall be connected to the start button to de-

energize the run contact when the low level float is energized to prevent pumping when the water is below the low level.

C. A grounding type convenience outlet shall be provided on the side of the cabinet for operation of 120 volt AC devices.

D. Thermal magnetic air circuit breakers shall be provided for branch disconnect service and short circuit protection of all motor control and auxiliary circuits.

E. To control the operation of the pumps with variations of liquid level in the wet well, a submersible level transducer and a Siemens Model LC150 with operating system shall be provided.

F. Control voltage shall be 120 VAC and shall be accomplished by a current transformer to be provided as part of the pump station control panel. A control fuse and on/off switch shall protect and isolate the control voltage from the line.

G. All ground connections shall be made with ring tongue terminals and star washers to assure proper ground. A dedicated control power transformer shall be provided for the LC150 controller.

H. The panel shall be equipped with the following options:

1. Lightning arrestor. A single phase lighning arrestor shall be supplied in the control panel and connected to each line of the incoming side of the power input terminals. The arrestor shall protect the control panel against damage as the result of transient voltage surges caused by lightning interference, switching loads, and power line interference. It shall begin shunting to ground at 500 volts maximum. The lighting arrestor shall be designed to withstand repeated transient voltage pulse currents up to 2,000 amperes.

2. Surge capacitor

I. An automatic alternator with manual switch shall be provided to change the sequence of operation of the pumps every eight hours. Alternating the pumps at less than eight-hour intervals will not be acceptable.

J. Provisions shall also be made for the pumps to operate in parallel, (second pair of pumps starting), should the level in the wet well continue to rise above the starting level for the lag pumps.

2.5 CONTROL SYSTEM

A. CONTROLLER. The controller shall be an Allen Bradley Micrologix, 1100/1763-L16BWA, by Rockwell Automation and shall be completely compatible to intereface and communicate with the Town of Watertown SCADA system.

B. PRIMARY TRANSDUCER LEVEL SYSTEM

The liquid level in the wet well shall be monitored by a submersible hydrostatic pressure transducer with stainless steel sensor diaphragm, providing a 4-20 mA signal to the pump control unit. The body of the transducer shall be made of 316 stainless steel. The pressure transducer shall have a permanent hermetically sealed connection to a polyethylene insulated cable, which shall support the transducer 6” from the bottom of the wet well, and shall pass

through a cord grip seal in the station base. The pressure transducer unit shall be rated for wastewater or potable water service, and for operation in explosion hazardous areas.

To control the operation of the pumps with variations of liquid level in the wet well, and the high and low water alarm functions, a specially preprogrammed, dedicated microprocessor-based control system shall be provided. The controller shall interface with the wet well level transducer, integral panel display unit, motor starters, and alarm functions as required.

The digital controls shall operate on 24 volts or less, to eliminate shock hazard. The 24-volt power supply shall be overload protected to be "crowbar safe" and will return to operation when a short is removed.

To reduce exposure to corrosive environments and ensure the control system's reliable, long-term operation, the controller shall have a sealed, user-friendly, graphical interface. The interface shall be comprised of a rotary knob, switches and five (5) columns of ultra-bright, daylight-viewable red LED's. Four (4) 40-segment, 4" columns of LED's shall show the wet well level, the pump on and off control bands, and the high and low alarm setpoint bands. All LED's within a control band shall be illuminated when operating under normal power. A fifth LED column shall indicate the controller's configuration, status and active alarms. Alarms shall consist of high alarm, low alarm and input signal out of range. Monitor functions shall include control power and normal system operation. Discrete LED's shall show the activation of the differential pump control stages.

The controller shall provide easy, convenient indication and adjustment of the operating setpoints and controller configuration without the need for tools. For ease of operation and configuration, multiple indicating columns are required. Controllers that provide fewer columns; thus, limiting the viewing of relevant and necessary station information, are specifically precluded by this specification.

The pump control circuits shall be forced OFF by power loss. Upon power restoration, the controller shall enable the pumps in an adjustable time-step sequence as required to meet the demand.

The controller shall continuously indicate the status of the selected alternation sequence and control modes. The controller shall provide 1st On/1st Off, Fixed and Auto Rotate alternation sequences.

Integral span, offset, and damping adjustments shall be easily adjustable. The controller shall have a configurable security lockout feature.

The controller shall contain a level simulation function that allows manual manipulation of the displayed process variable. While simulating, the controller shall display both the actual wet well level and the simulated level.

The controller shall contain an RS-232 communication port and have capabilities for connection to a SCADA (Supervisory Control and Data Acquisition) system using Modbus® protocol. The complete assembly shall be designed for use in UL508 Industrial Control Panels.

It is the specific intention of this functional requirement that a controller shall be provided with features as described herein. Additionally, this controller shall be a fully integrated assembly and fully compatible with the Town of Watertown SCADA system.

C. BACKUP FLOAT SWITCH LEVEL CONTROL

1. Three (3) displacement switches shall be provided to automatically operate the pump in back-up mode, in case of failure of the digital control system or the submersible level transducer. The back-up system shall be entirely independent of the digital system. A 30' color-coded cord shall be provided with each switch. The cord shall have a corrosion-resistant vinyl jacket and be multi-stranded in order to prevent fatigue. The displacement switch cords and the cable for the submersible pressure transducer shall enter the wet well through cord grip seals.
2. An automatic alternator with manual switch shall be provided to change the sequence of operation of the pumps every eight hours. Alternating the pumps at less than eight-hour intervals will not be acceptable.
3. Provisions shall also be made for the pumps to operate in parallel should the level in the wet well continue to rise above the starting level for the lag pumps.

2.6 AUTOMATIC ALARM MONITOR/DIALER

A. The dialer/monitor shall be microprocessor based device that shall sense alarm contacts at the site. The unit shall be provided in an 8 channel configuration. In addition, power failure shall be sensed internally and shall not require using any of the alarm channels. Upon detection of any of the alarm conditions or power failure, the device shall commence dialing the first of eight (8) user programmed phone numbers and deliver a message describing the actual alarm condition. The unit shall be capable of storing and using up to 64 telephone numbers, in lists of 8 or 16 numbers per list. Messages shall be delivered in the user's own recorded voice, digitized and stored in a non-volatile memory, not magnetic mode.

B. The dialer shall be capable of working with fixed or cellular telephones, and be capable of signaling pagers.

C. Message programming shall be accomplished by speaking into the device's built-in microphone, or by utilizing a touch tone telephone, and shall not be limited to a factory supplied internal synthesized speech vocabulary. Complete programming shall be accomplished using the sealed membrane keypad, or the 10-key pad on a touch tone phone from any location.

D. The message as heard by the caller shall consist of two parts, the actual device location and the user recorder alarm message. The device will continue to call the phone numbers in succession until acknowledged by the caller using a touch tone key or calling the unit back from any phone. Once acknowledged, the device shall enter a programmable inter-call delay, to allow the alarm condition to be corrected, before beginning notification again. The device shall, upon receipt of an incoming call, provide the caller with the device identifier alarm status.

E. All communications shall utilize standard telephone lines, and shall not require leased or dedicated lines.

F. The automatic alarm monitor/dialer shall possess the following physical and functional characteristics:

- NEMA 4/4X enclosure
- On-board battery backup, with charging circuit, to provide a minimum of 10 hours of telephone calls on loss of power.
- All programmed variables shall be stored in non-volatile memory.
- Individually selectable alarm delay times-keyboard programmable from 0-999 seconds.
- Programmable selection of each alarm input to be either “Enabled”, “Disabled”, or “Status” only (status only will not initiate a call).
- Each alarm input can be configured to monitor either normally open or normally closed contacts.
- Each alarm input shall have its own prioritized calling sequence from the programmed telephone list of sixty-four (64) telephone numbers.
- Individually programmable inter call delay, from 0-9999 minutes.
- Tone or pulse dialing format.
- Visual indications of the following conditions, even when the cover is closed:
  - Status of all alarm channels
  - Power on
  - Incoming call
  - Low battery
  - Run/Bypass operation
  - Off hook
  - Phone fault

  - Transient protection on the telephone and power lines shall be included.
  - The dialer shall include a standard RS-232 port for connection to a standard serial printer, to report all dialer operations and activities, including time and date stamp.
  - A standby mode shall disable the dial out function during specific, programmable, hours and minutes, based on weekday/weekend times.
  - A listen-in feature shall allow the incoming caller to monitor the physical activity at the dialer location.

G. The alarms to be monitored are as follows:

- High and low wet well level alarm
- Pump failure No. 1
- Pump failure No. 2
- Power failure

H. The alarm dialer shall be manufactured by Napco; Kaye, Model ADAS di**a**log plus; RACO or Verbatim. A spare circuit breaker shall be provided for the dialer.

2.7 VACCUM-PRIMING SYSTEM

A. A vacuum priming system shall be furnished to prime the main pumps. The system shall include two vacuum pumps, providing 100 percent standby. Vacuum pumps shall have corrosion-resistant internal components. The vacuum priming system shall be complete with vacuum control solenoid valves, prime level sensing probes, float-operated check valves to protect the vacuum pumps, and all necessary shut-off valves as shown on the piping schematic. The float-operated check valves shall have a transparent body for visual inspection. Two vapor filters installed in series shall be

provided for each vacuum pump. All vacuum tubing shall be connected with compression fitting and metal farrells.

B. The priming system shall automatically provide positive lubrication of the mechanical seal each time a main pump is primed. To prevent excessive stoppage due to grease accumulation, no passageway in the priming system through which the pumped must pass shall be smaller than the equivalent of a 2-1/2" opening.

2.8 ENVIRONMENTAL EQUIPMENT

A. A ventilating blower capable of delivering 250 CFM at 0.1" static water pressure shall be provided in order to remove the heat generated by continuous motor operation. The ventilating blower shall be turned on and off automatically by a preset thermostat. A louvered opening shall cover the discharge. A 500 watt electrical heater controlled by a preset thermostat shall be furnished. The heater shall be rigidly mounted in the station to prevent removal. The contractor shall be responsible for installing and wiring this equipment.

2.9 CORROSION PROTECTION

A. All structural steel surfaces shall be factory blasted with steel grit to remove rust, mill scale, weld slag, etc. All weld spatter and surface roughness shall be removed by grinding. Surface preparation shall comply with SSPC-SP6 specifications. Immediately following cleaning, a single 6-mil dry film thickness of epoxy resin coating shall be factory applied. Stainless steel, aluminum and other corrosion-resistant surfaces shall not be coated. Carbon steel surfaces not otherwise protected shall be coated with a suitable non-hardening rust preventative compound. Auxiliary components, such as the electrical enclosure, ventilating blower and vacuum pumps, shall be furnished with the original manufacturer's coating.

B. Finish coating shall be accomplished prior to shipment of the station from the factory and shall comply fully with the intent of these specifications. A touch-up kit shall be provided by the pump station manufacturer for repair of any mars or scratches occurring during shipping and installation. This kit shall contain detailed instructions for use and shall be the same material as the original coating.

2.10 MAIN PIPING

A. The pump suction shall be drilled and tapped for a 125 pound American Standard flange for easy connection of the suction riser. The discharge line from each pump shall be fitted with a clapper-type check valve and eccentric plug valve. Size, location and quantity of check valves and plug valves shall be shown on the construction drawing. The check valve shall be of the spring-loaded type with external lever arm and an easily replaced resilient seat for added assurance against vacuum leaks. Check valves shall have stainless steel shaft with replaceable bronze shaft bushings and shall be sealed with an adjustable Teflon seal. An operating wrench shall be provided for the plug valves.

B. Protrusions through the floor plate shall be gas-tight where necessary to effect sealing between the equipment chamber and the wet well. Bolted and sealed joints shall be provided at the pump casing or suction pipes in order to prevent corrosive, noxious fumes from entering the station. The pump station manufacturer shall extend the suction and discharge connections below the floor plate at the factory so that field connections can be made without disturbing the gas tight seals.

C. The manufacturer of the pump station shall provide a compression-type sleeve coupling for installation in the common discharge pipe.

D. Compound discharge and suction gauges for each pump shall be provided.

2.11 FACTORY TESTS

A. All components of the pump station shall be given an operational test at the pump station manufacturer's facility to check for excessive vibration or leaks in the piping or seals, and to correct operation of the automatic control and vacuum priming systems and all auxiliary equipment. Installed pumps shall take suction from a deep wet well, simulating actual service conditions. The control panel shall undergo both a dry logic test and a full operational test with all systems operating.

B. Factory test instrumentation must include flow measuring with indicator; compound suction gauge; bourdon tube type discharge pressure gauge; electrical meters to measure amperes, volts, kilowatts and power factor; speed indicator; and a Vibrometer capable of measuring both amplitude and frequency.

2.10 SPARE PARTS

A. The following spare parts shall be provided to the Owner at the completion of construction of the project:

1. A complete replacement pump shaft seal assembly for each pump
2. A spare volute casing gasket and seal gasket for each pump
3. Two (2) spare electrode dome assemblies
4. Two (2) spare float ball assemblies

PART 3 - EXECUTION

3.1 COORDINATION WITH OTHER CONTRACTS

A. The sanitary sewer to be connected to is being constructed under a separate construction contract. The Contractor is required to coordinate schedule and construction installation with that Contractor before testing and tie in will be permitted.

3.2 START UP AND PERFORMANCE:

A. The Contractor shall furnish the services of a manufacturer's factory representative satisfactory to the Engineer to check the station during and after the installation to make all necessary adjustments for the design service and to instruct an operator designated by the Owner in its proper operation and maintenance. Prior to start-up, the Contractor shall ensure that all equipment is properly lubricated.

B. The Contractor shall demonstrate to the satisfaction of the Engineer that all functions and capacities of the station and system are in accordance with the design requirements as indicated by the Contract Documents.

3.3 GUARANTEE:

A. The manufacturer of the pumping station shall furnish the Owner, through the Contractor, guarantee for a duration as described in the Contract Documents (from date of acceptance of the finished work) that the structure and all equipment shall be free from defects in design, material and workmanship. During this guarantee period, the Contractor shall furnish replacement parts for any component proven defective, whether of his own or other manufacture, excepting those items which are normally consumed in service such as lamp bulbs, lubricants, etc. A guarantee shall be furnished for all other work furnished. The labor, required to repair or replace major items proven defective, including the structure, sewage pumps and/or motors, valves or fittings during this guarantee period, shall also be furnished without charge. The Owner shall have the right to request replacement in lieu of repair for equipment that fails within the first six months on installation.

END OF SECTION 333213.13A.4

SECTION 333213.13B.2 RECESSED WET WELL MOUNTED DUPLEX PUMP STATION
PUMP STATION NO. 1

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications sections, apply to work specified in this section.

B. Comply with requirements of applicable Section 300000 – Form 816 Site Work for excavation and backfilling required in connection with Pump Station No. 1.

C. Comply with requirements of applicable Division 3 Sections for concrete work required in connection with sanitary sewer system.

1.2 DESCRIPTION OF WORK

A. Extent of Recessed Wet Well Mounted Duplex Pump Station work is shown on the drawings and described herein or as otherwise necessary for a complete installation at Pump Station No. 1. The work includes but is not limited to the following:

1. Recessed Wet Well Mounted Pump Station including pumps, motors and associated equipment
2. Wet well chamber
3. Submersible Level Transducer & PLC based control system with redundant float system.
4. Control panel with motor starting equipment
5. Electrical work (All wiring and including that from control panel to the power supply, including enclosures)
6. Gravity Sewer, Force Main piping, and accessories associated with pump station.
7. Communication Line from pump station controller to control center in main building.
8. Excavation, Dewatering, Backfill, Fill material, and Compaction
9. Pig Launcher
10. Testing
11. Concrete work
12. Landscaping, Restoration, and other site work

B. The pump station shall be as manufactured by Smith & Loveless, Inc.. These specifications are based on the Smith & Loveless, Inc. and are not intended to be restrictive but to convey the intent and performance of the pump station equipment. The pump station shall conform to the manufacturer's published specifications and the requirements of these contract documents. The station shall be complete with all needed equipment. The principal items of equipment shall include two vertical, closed coupled, motor driven, vacuum primed, X-PELLER super clog resistant mono port impeller; valves; internal piping; central control panel with circuit breakers; motor starters and automatic pumping level controls; heater; ventilating blower; dehumidifier; priming pumps and appurtenances; and all internal wiring.

C. The Contractor shall furnish, install and coordinate telephone, and power for the pump station

and appurtenances as required for each utility.

1.3 ANTI-FLOTATION

A. The Contractor shall supply appropriate anti-flotation calculations for the proposed chamber and shall not take credit for weight of equipment in the chamber or for external soil load. Also, the water table shall be assumed to be at the ground surface. The anti-flotation calculations shall be signed and sealed by a Connecticut State licensed Professional Engineer and be submitted with the shop drawings for review by the Engineer.

B. If concrete is used for anti-flotation, the concrete mass shall be reinforced and proposed attachment to the chamber shall be submitted with the anti-flotation calculation.

1.4 ACTIONS SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTORS-SUBMITTALS.

B. Product Data: Submit a minimum of six (6) shop drawings from each manufacturer of materials and equipment to be incorporated in the construction of the recessed wet well mounted duplex pump station.

C. Maintenance Data: For Recessed Wet Well Mounted Duplex Pump Station, Pump Station No. 1 to include in emergency, operation, and maintenance manuals specified in Form 816 Article 1.20-1.08.14 subsection 2 and described in NOTICE TO CONTRACTOR - CLOSEOUT DOCUMENTS.

1.5 NOTIFICATIONS

A. Notify the Engineer of the starting date of recessed wet well mounted pumping station construction, in writing, five (5) days in advance of construction.

1.6 GENERAL

A. Provide manufacturer's standard packaged, pre-engineered, pre-fabricated units with selections as indicated to comply with requirements; and with components of each unit complying with manufacturer's published product literature, and as required for a complete operable system.

1.7 PROTECT FROM DAMAGE

A. From the time the pump station is delivered until final acceptance of the completed pump station, the Contractor shall protect the pump station from any and all damage including flooding or freezing. The Contractor shall make periodic inspections of the pump station to check for any possible problems including flooding or equipment failure. In the event of damage due to Contractor failing to maintain the pump station as outlined above, all expenses necessary to restore the pump station to an acceptable condition as determined by the Owner, shall be borne by the Contractor.

PART 2 - MATERIALS

2.1 PRE-PACKAGED PUMP STATION:

A. The station shall be constructed in one complete factory-built assembly. Pump duty points are shown on the drawings. It shall be sized to rest on top of the wet well as detailed in the construction drawings. The floor and shall be durolast stainless steel, minimum 3/8" thick steel with reinforcing, as required, to prevent deflection and insure an absolutely rigid support. The shell shall be 1/4" minimum thickness ASTM A-36 steel plate rolled to 8'-0" by 11’-1/2” floor dimension.

B. The equipment chamber shall be provided with a two piece fiberglass cover equipped with locking hasp. The fiberglass covers shall be formed with a drip lip around the edge. A gravity type lid support shall be provided to lock the lid in the open position and restrain it under load.

C. Wet well access shall be completely separate from the equipment chamber and shall be provided with the access manway exposed only to the atmosphere. A steel manway cover located exterior to the pump chamber shall be provided. The manway shall be an integral part of the station head plate and shall provide access into the wet well. The wet well access cover shall be provided with a locking hasp.

D. An aluminum ladder shall be located in the station to provide easy access.

E. Two (2) pump-motor swing arm hoist brackets and sockets shall be provided and installed inside the pump chamber to assist in pump-motor maintenance and removal.

2.2 PUMP CONSTRUCTION:

A. The pump casing shall be of gray iron construction with heavy sections to provide long life under abrasive and corrosive conditions, accurate alignment, and reliable operation.

B. The impellers shall be capable of passing a maximum of a 3” spherical solids size. Impellers shall be statically and dynamically balanced at the maximum operating speed.

C. Seals shall be of carbon and ceramic materials with the ceramic mating surface lapped to a flatness tolerance of one light band in a bronze seal housing.

D. The pump shaft shall be a minimum of 1-7/8" diameter solid stainless steel and not exceed 6" from the lower bearing to top of impeller.

E. Lower bearings shall be of the thrust type and certified by the manufacturer.

F. Suction reducers shall be one piece, heavy section, of the same material as the pump casing. Priming passages shall be a minimum of 2½” opening.

G. The pump base shall be of sufficient strength to support the entire weight of the assembled pump as well as all stresses imposed thereon due to vibration, shock, and all possible direct and eccentric loads.

H. Motors

1. Two (2) motors manufactured by the pump supplier shall be supplied. Motors shall be sized to provide completely non-overloading characteristics throughout the entire operating range of pump.
2. The pump motor shall be guaranteed to run continuously without damage. Motor shall be open, drip-proof design with forced air circulation by integral fan. Openings for ventilation shall be uniformly spaced around the motor frame. Motors shall be 480V, (60Hz), three (3) phase, 3 wire with ground.
3. The motor shall be fitted with heavy lifting eyes or lugs, each capable of supporting the entire weight of the pump and motor.
4. Motor sizes for Pump Station No. 1 are listed on the plans in the equipment list shown on the plan sheet.

2.3 MAIN PIPING

A. The pump suction shall be drilled and tapped for a 125 pound American Standard flange for ready connection of the suction riser. The discharge line from each pump shall be fitted with a clapper-type check valve and eccentric plug valve. Size, location, and quantity of check valves and plug valves shall be as shown on the plans.

B. The check valve shall be of the spring-loaded type with external lever arm and an easily replaced resilient seat for added assurance against vacuum leaks. Check valves shall have stainless steel shaft with replaceable bronze shaft bushings and shall be sealed with an adjustable Teflon seal. An operating wrench shall be provided for the plug valves.

C. Protrusions through the floor plate shall be gas-tight where necessary to effect sealing between the equipment chamber and the wet well. Bolted and sealed joints shall be provided at the pump casing or suction pipes in order to prevent corrosive, noxious fumes from entering the station. The pump station manufacturer shall extend the suction and discharge connections below the floor plate at the factory so that field connections can be made without disturbing the gas tight seals.

D. The manufacturer of the pump station shall provide a compression-type sleeve coupling for installation of the common discharge pipe.

E. Suction and discharge connections shall be ANSI B16.1 125 lb, flat face flanges. Interior station piping shall be polyvinylchloride (PVC), Sch. 80 with bolted fittings.

F. Suction pipe support brackets shall be furnished and installed as necessary as shown or noted on the plans or as otherwise determined.

G. Compound Pressure gauge on pump discharge (0-30 psi) shall be provided with bronze hardware with 1/4" NPT taps and corporation stop, pressure rated for this application.

2.4 VACUUM PRIMING SYSTEM

A. A separate and independent priming system will be furnished for each sewage pump, providing complete standby operation and as follows:

1. Each priming system shall include a separate vacuum pump. Vacuum pumps shall have corrosion resistant internal components and shall have a capacity of not less than 6.6 SCFM air flow at 0" hg.

2. Each priming system shall be complete with vacuum pump, vacuum control solenoid valve, prime level sensing probe and a float operated check valve installed ahead of the vacuum pump. The float operated check valve shall have a transparent body and shall be automatically drained when the vacuum pump shuts off. All vacuum tubing shall be connected by compression fittings with ferrules.

3. The priming system shall automatically provide positive lubrication of the mechanical seal each time the sewage pump is primed.

2.5 FACTORY TESTS

A. All components of the pump station shall be given an operational test at the pump station manufacturer’s facility to check for excessive vibration or leaks in the piping or seals, and to correct operation of the automatic control and vacuum priming systems and all auxiliary equipment. Installed pumps shall take suction from a deep wet well, simulating actual service conditions. The control panel shall undergo both a dry logic test and a full operational test with all systems operating.

B. Factory test instrumentation must include flow measuring with indicator; compound suction gauge; bourdon tube type discharge pressure gauge; electrical meters to measure amperes, volts, kilowatts and power factor; speed indicator; and a Vibrometer capable of measuring both amplitude and frequency.

2.6 WET WELL

A. The wet well shall be pre-cast reinforced concrete as shown on the plans or otherwise specified. The chamber shall have openings with sleeves and watertight mechanical seals as necessary for vents, pipes and conduits.

B. The entire interior and exterior surfaces of the concrete wet well are to be coated with Bitumastic coating.

2.8 PUMP CONTROL PANEL

A. A control panel shall be furnished by pump station manufacturer and shall incorporate “Siemens” LC150 pump controller and A1000 submersible level transducer as shown on the plans and/or as described in the contract documents. The control panel and its installation shall meet the applicable National Electrical Code requirements for such locations.

B. Panel - The Contractor shall furnish and install the pump station manufacturer's standard control panel and control equipment and place into operation a pump control center. The control

equipment shall be manufactured by a U.L. approved shop and labeled to that effect and as follows:

1. All wiring shall have not less than 600 volt insulation and all power wiring and bus shall be in complete conformity with the National Electrical Code and NEMA Electrical Standards. Control wiring shall be color coded. All job connections required to conveniently replace control components shall be made at approved type terminal blocks and identified by an approved means.

2. The control panels shall be constructed in compliance with Underwriter's Laboratories Industrial Control Panels and bear the Underwriter's Laboratory listed serialized label.

C. The described equipment shall be housed in a NEMA 12 enclosure with a removable access cover and shall be constructed of not less than 14 gauge cold rolled steel. The enclosure shall be phosphatized before painting. It shall have an ANSI 61 Gray polyester powder interior and exterior coating.

D. The recessed pump control panel shall be installed and mounted in the equipment chamber.

E. Nameplates - All major components and sub-assemblies shall be identified as to function with laminated, engraved nameplates, or similar approved means.

F. The following described equipment shall be furnished in the control panel and matched to the specified pumping station equipment:

1. Main Circuit Breaker - The control panel shall include a U.L. service entrance rated main circuit breaker. The circuit breaker shall be pad-lockable and be interlocked with the inner door.

2. Lightning Arrestor - A lightning arrestor shall be supplied in the control panel and connected to each line of power input terminals. The arrestors shall protect the controls against damage due to lightning strikes on the incoming power line.

3. Branch Circuit Protection - A thermal magnetic molded case industrial type circuit breaker shall be supplied as branch circuit protection for each pump motor and auxiliary circuits. The circuit breaker must have a minimum interrupting capacity of 10,000 symmetrical RMS amps. The circuit breakers shall be operable through the inner door of the enclosure.

4. Motor Starters - A Nema rated full-voltage across the line magnetic motor starter with ambient-compensated, quick-trip class 10 overload sensing in each phase to provide over current and running protection shall be provided for each pump motor. Over current protection shall be provided by accurately sized heater elements. Door mounted overload reset pushbuttons shall be provided.

   a. Each motor starter coil and H-O-A selector switch shall be powered with 120 VAC control power.

5. Wiring Devices

a. A hand-off-auto 3 position, oil tight, heavy duty type selector switch shall be mounted on the door front for each pump.

b. A door front mounted, 1" diameter, oil tight "red" pilot light operated in parallel with its respective starter coil shall be provided to indicate a "pump running" condition.

6. Cabinet Heater - A 120 VAC condensation protective heater and high temp cutout shall be supplied in the control cabinet. The heater shall be 400 watt, 115 VAC.

7. GFI Receptacle - A 120 VAC (20 amp) GFI duplex receptacle shall be provided on the dead-front panel.

8. Running Time Meter - A running time meter measuring hours and tenths of hours of operation up to 99999.9 hours shall be furnished for each pump motor indicated. This shall be a 120 volt AC device operating in parallel with the motor starter coil.

9. This specification is intended to cover a complete and operational automatic pump and alarm control system that responds to the wastewater pumping station wet well level excursions.

a. The control equipment will be connected with the submersible transducer to provide pump operation as demanded by the quantity of sewage in the pump chamber. The pump motors shall respond to level signals for pumps off, lead pump on, lag pump on, and alarm on. Also, provisions shall be made to alternate the lead and lag pump on each successive operation cycle. A manual override switch for lead-lag alternation shall be provided. Sequential starting shall be ensured. The lag pump shall operate as the standby pump. Control equipment shall be intrinsically safe.

b. The system shall sense the station wet well liquid level over a calibrated range, graphically display eight level adjustments for automatic pump control and abnormal level alarm in a coordinated arrangement with the level display and provide automatic operation of the station pumps and alarms as hereinafter described.

c. Under emergency power operations, one pump shall be "locked out" to prevent starting while the other is running. Provisions shall be made for either pump to operate in the automatic mode, should one pump be out of service.

10. Controller - The controller shall accept a single, level proportional analog input signal and provide automatic operation of two pumps, pump alternation and alarms and as follows:

a. It shall display the sensed control level on a 40-segment LED bar graph display. The level shall be displayed in a 0-10 foot range with 3" resolution respectively.

b. The controller shall operate directly with the A1000 level sensing transducer. The controller shall include transducer excitation voltage regulation, signal spanning, offsetting and "quelling" (rate-of-change-limiting).

c. Directly aligned with the calibrated L.E.D. bar graph display shall be 8 vertical receptacles with programming pins and adjacent range scales to match the calibrated bar graph giving full-range, level-differential, On/Off operation of pumps and alarms from the sensed level excursion. The receptacles and programming pins shall be gold-plated. A red LED indicator shall be provided on the front of the controller to indicate when the stage output is activated in either the control/alarm stage.

11. A 3-position "raise-auto-lower" manual level simulator shall allow the manual creation of a "false signal" when the switch is raised or lowered from the central auto position. By use of this switch, the effective operation of each pump shall be confirmed and the station returned to normal without danger of leaving the station in a "non-automatic" condition.

12. The controller shall operate with a power supply 120 VAC input power acquired from the control panel and include fusing and transient protection.

13. The Low and High Level Alarm shall provide an adjustable level-responsive alarm output and include abnormal level alarm annunciation with a front accessible silence pushbutton.

14. The controller shall include an integral duplex solid-state automatic alternator with a 3-position auto alternator override switch (1-2, auto, 2-1) mounted on the front of the controller.

15. The controller front face shall be semi-flush mount in a control panel inner door.

a. The electrical equipment is shown on the electrical single line diagram in the plans. The single line indicates the minimum equipment. Any other equipment required shall be shown on the shop drawings. The shop drawings shall clearly indicate connection requirements of equipment supplied by other manufacturers.

Note: The controller's pump #2 starter control circuit shall have provisions for interlocking a "run" permissive from the Transfer Switch. It shall be the Contractor's responsibility to either modify the starter circuit in the field or specify to the pump manufacturer to provide the circuit modifications and terminal blocks (Refer to the plans for schematic details).

16. Level Sensor- The liquid level of the wet well shall be sensed by a “Siemens” A1000 Solid State submersible level transducer. The transducer shall be a 3-wire type to operate from a supply voltage of 13.8 VDC acquired from the LC150 control panel and produce an instrumentation signal in direct proportion to the measured level excursion over a factory-calibrated range of zero to 10 feet of water and as follows:

17. A dedicated control power transformer shall be provided to isolate the controller.

18. The sensor shall be of the head-pressure sensing type, suitable for continuous submergence and operation and shall be installed in accordance with manufacturer's instructions. See drawing details for location and installation details.

19. The transducer housing shall be fabricated of type 316 stainless steel. The internal pressure of the lower transducer assembly shall be relieved to atmospheric pressure through a heavy-duty urethane jacketed hose/cable assembly and a slack PVC bellows mounted in the splice box shown on the plans. The sealed breather system shall compensate for variations in barometric pressure expansion and contraction of air due to temperature changes.

20. The transducer shall incorporate a variable-capacitance transducer element to convert the sensed pressure to a corresponding electrical value. The transducer shall provide a precise, reliable, stable output signal directly proportional to the sensed pressure over a factory-calibrated range. The transducer element shall incorporate high over-pressures up to 50 psi, or five times the full scale, whichever is greater. Metallic diaphragms shall not be acceptable.

21. The sensor shall be suspension mounted using a Cable Suspension Mounting Kit consisting of a 2' long, 1" diameter type 316 SS pipe with coupling, bolt, cable clamps and hardware along with the required length of 1/8" diameter, 7 x 19 SS cable. The cable shall enter the splice box in the equipment room (see plans). The Contractor shall furnish a 3-wire shielded cable and conduit between the splice box and pump control center.

22. Three (3) back-up floats shall be incorporated into the pump station control system to start and stop the pumps if the submersible transducer fails. The switch over to the floats shall be automatic. The third float (high level float) shall be wired directly to the facility SCADA system.

23. A back-up float system shall be incorporated using a CB1T controller to operate the pumps (start and stop) should the controller fail, with two stainless steel floats and stainless steel suspension weight kit.

2.9 AUTOMATIC ALARM MONITOR:

A. Coordinate with the Owner and the pump station vendor to install communication line from pump station to Owner’s control room in the facility. The intent shall be to allow the owner to receive and monitor all status and alarm conditions from the pump station at the facility control room. The system shall be installed from the pump station to the control room designated to monitor pump station status and alarm. Upon detection of any of the alarm conditions or power failure, the system shall deliver a message describing the actual alarm condition within the facility control system.

B. The alarms to be monitored are as follows:

- High and low wet well level alarm
- Pump failure No. 1
- Pump failure No. 2
- Power failure

C. The alarms shall be connected to the owners existing I/O system, provide all wiring, I/O modules and programming necessary for annunciation of alarms, review with owner for existing system details.

2.10 EQUIPMENT CHAMBER:

A. The chamber shall have the following equipment as a minimum:

1. Fluorescent lights and the guard for the lights. The lights shall be activated by a limit switch when chamber lid is open.

2. Ventilating blower capable of delivering 40 air changes per hour at 200 CFM in the chamber and shall be operating on a percentage timer. The blower shall also be operated by a limit switch which is activated when the chamber lid is opened.

3. Weatherproof air intake vent and exhaust vent.

4. A dual wattage forced air heater with built-in thermostat shall be provided.

5. A submersible sump pump installed in the sump and rated at 500 GPH with an automatic float switch.

2.11 TELEPHONE AND ELECTRICAL WORK

A. All electrical equipment, components, panels and conductors, etc., required by these specifications and necessary to operate the Pump Station shall be sized and installed in accordance with the requirements of the National Electrical Code and these specifications.

B. The Contractor shall furnish and install all electrical and telephone service conduit and wiring needed to operate the pumping station and its appurtenances and to complete the connections to the Power Company equipment, including the meter, etc. The underground services shall be in conformance with all requirements of the National Electrical Code, the utility company's requirements and the plans and specifications.

C. All conduit for feeders to control panels shall be rigid metal hot-dipped galvanized finish, heavy wall conduit. All branch circuit conduits from control panels to appurtenances shall be liquid tight flexible metal. Conduits shall be adequately secured. All joints shall be reamed to remove burrs and imperfections and shall be watertight. Interior surfaces at joints must be smooth.

D. All electrical or telephone conductors that enter or exit from any electrical equipment panels,

junction boxes, or mounting boxes in the wet well or pump chamber, shall be sealed watertight at the joint where the insulation and/or jacket have been stripped from the conductor.

E. Secure the lifting cable inside the manway when not in use.

2.12 CORROSION PROTECTION

A. All structural steel surfaces shall be factory blasted with steel grit to remove rust, mill scale, weld slag, etc. All weld spatter and surface roughness shall be removed by grinding. Surface preparation shall comply with SSPC-SP6 specifications. Immediately following cleaning, a single 6-mil dry film thickness of coating epoxy resin shall be factory applied. Stainless steel, aluminum and other corrosion-resistant surfaces shall not be coated. Carbon steel surfaces not otherwise protected shall be coated with a suitable non-hardening rust preventative compound. Auxiliary components, such as the electrical enclosure, ventilating blower and vacuum pumps, shall be furnished with the original manufacturer's coating.

B. Finish coating shall be accomplished prior to shipment of the station from the factory and shall comply fully with the intent of these specifications. A touch-up kit shall be provided by the pump station manufacturer for repair of any mars or scratches occurring during shipping and installation. This kit shall contain detailed instructions for use and shall be the same material as the original coating.

C. Four (4) 17-pound magnesium anode packs shall be provided and installed for cathodic protection.

2.13 SITE WORK

A. Restoration and landscaping, service driveway construction within and beyond the limits of the site, and other site improvements described in the specifications or shown on the plans shall be included in this item. Applicable requirements of other items in the specifications shall apply unless otherwise specified or shown, however, no direct payment shall be made under those items.

B. Landscaping shall include preliminary cleanup, rough grading, finish grading, topsoil and seeding and planting within the site as shown on the plans.

2.14 SPARE PARTS

A. The following spare parts shall be provided to the Owner at the completion of construction of the project:

1. One (1) complete replacement pump shaft, mechanical seal assembly for each pump installed

2. One (1) complete set of wear rings for each pump installed

3. One (1) spare volute casing gasket for each pump installed

4. Four (4) spare vacuum pump filters

5. Two (2) spare electrode dome assemblies

6. Two (2) float ball assemblies

7. One (1) spare controller

PART 3 - SERVICE

3.1 START UP AND PERFORMANCE:

A. The Contractor shall furnish the services of a manufacturer's factory representative satisfactory to the Engineer to check the station during and after the installation to make all necessary adjustments for the design service and to instruct an operator designated by the Owner in its proper operation and maintenance. Prior to start-up, the Contractor shall ensure that all equipment is properly lubricated.

B. The Contractor shall demonstrate to the satisfaction of the Engineer that all functions and capacities of the station and system are in accordance with the design requirements as indicated by the Contract Documents.

3.2 GUARANTEE:

A. The manufacturer of the pumping station shall furnish the Owner, through the Contractor, guarantee for a duration as described in the Contract Documents (from date of acceptance of the finished work) that the structure and all equipment shall be free from defects in design, material and workmanship. During this guarantee period, the Contractor shall furnish replacement parts for any component proven defective, whether of his own or other manufacture, excepting those items which are normally consumed in service such as lamp bulbs, lubricants, etc. A guarantee shall be furnished for all other work furnished. The labor, required to repair or replace major items proven defective, including the structure, sewage pumps and/or motors, valves or fittings during this guarantee period, shall also be furnished without charge.

END OF SECTION 333213.13B.2

SECTION 334100 - STORM UTILITY DRAINAGE PIPING & STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications sections, apply to work specified in this section.

B. The following are minimum requirements and shall govern, except that local, state and/or federal codes and ordinances shall govern when their requirements are in excess hereof.

1.2 SUMMARY

A. Provide labor, material and equipment necessary to complete site drainage as shown on the drawings and as specified herein.

1. Installation of drainage structures and castings.
2. Installation of backwater valves.

B. Section Includes:

1. Backwater valves.
2. Channel drainage systems.
3. Yard drains.

C. Related Section

1. Division 01, High Performance Buildings Requirements Section 018113.13 for credit 16a-38k-4(d)9 and 16a-38k-4(d)11.
   a. The above listed HPB credits are related to this section. Other HPB credits may apply and shall be reviewed for their potential applicability and conformed with as though listed.

2. Section 300000 – Form 816 Site Work

1.3 DEFINITIONS

A. ABS: Acrylonitrile-Butadiene-Styrene plastic.

B. EPDM: Ethylene-Propylene-Diene-Monomer rubber.

C. HDPE: High Density Polyethylene plastic

D. PVC: PolyVinyl Chloride plastic.

E. FRP: Fiberglass-reinforced plastic

1.4 ACTION SUBMITTALS

A. Submit the following in accordance with Form 816 Article 1.20-1.05.02 and NOTICE TO CONTRACTOR – SUBMITTALS

B. Product Data: For each type of product indicated.

C. Shop Drawings:

1. Channel drainage system. Include plans, elevations, sections, details, frames and grates.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

B. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures and fittings in direct sunlight.

B. Protect pipe, pipefitting, and seals from dirt and damage.

C. Handle precast concrete structures according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Site Information: Review site survey, research public utility records, and verify existing utility locations. Verify that storm sewerage system piping may be installed in compliance with original design and referenced standards.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

1.8 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of storm sewage system's products of types, materials, and sizes required, whose products have been satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Plumbing Code Compliance: Comply with applicable portions of National Standard Plumbing Code pertaining to selection and installation of storm sewage system's materials and products.

C. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to storm sewerage systems.

D. Utility Compliance: Comply with local utility regulations and standards pertaining to storm sewerage systems.

1.9 COORDINATION

A. Coordinate with interior building storm drainage piping.

B. Coordinate with other utility work.

1.10 COOPERATION

A. Examine Drawings and Specifications for other Contracts to determine nature of proposed construction. Perform work to conform to construction called for in such a manner as not to interfere or delay work of other Contractor's.

PART 2 - PRODUCTS

2.1 POLYMER-CONCRETE, CHANNEL DRAINAGE SYSTEMS

A. General Requirements for Polymer-Concrete, Channel Drainage Systems: Modular system of precast, polymer-concrete channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling. Include quantity of units required to form total lengths indicated.

B. Manufacturers: Subject to compliance with requirements, provide products by one the following:

1. ABT, Inc.
2. ACO USA.
3. Poly-Cast.

C. Sloped-Invert, Polymer-Concrete Systems:

1. Channel Sections:

a. Interlocking-joint, precast, modular units with end caps.
b. 6-inch inside width and deep, rounded bottom, with built-in invert slope of 0.6 percent and with outlets in quantities, sizes, and locations indicated.
c. Extension sections necessary for required depth.
d. Frame: Include gray-iron or steel frame for grate.

2. Grates:

a. Manufacturer's designation "Heavy Duty," with slots or perforations that fit recesses in channels.
b. Material: Ductile iron.

3. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

D. Drainage Specialties: Precast, polymer-concrete units.

1. Large Catch Basins:

a. 24-by-12-inch (610-by-305-mm) polymer-concrete body, with outlets in quantities and sizes indicated.
b. Gray-iron slotted grate.
c. Frame: Include gray-iron or steel frame for grate.

E. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.

F. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.2 BACKWATER VALVES

A. Cast-Iron Backwater Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Series R-5050-SF24 gray iron flap gate as manufactured by Neenah Foundry Co.

2. Description: All moving parts must operate on stainless steel hinge pins. Supply the gray iron flap gate with necessary stainless steel parts and accessories required for a complete, properly operating installation. Fabricate the seat in one piece with a raised section around the perimeter of the waterway.

   a. Body, cover, hinges, hinge arm: Gray iron meeting ASTM A48 Class 35B
   b. Hinge bushing: Type 304 Stainless Steel Hinge Pins
   c. Flap: Gray iron meeting ASTM A48 Class 35B
   d. Fasteners: Stainless steel bolts 7/8” diameter

2.3 YARD DRAINS

A. Plastic Yard Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ADS Inc.
   b. IPS Corporation.
   c. Zurn Plumbing Products Group.

2. Description: PVC surface drainage inlets shall be of the inline drain type as indicated on the contract drawings and referenced within the contract specifications. The ductile iron grates for each of these fittings are to be considered an integral part of the surface drainage inlet and shall be furnished by the same manufacturer.

3. Materials:
   a. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. This joint tightness shall conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals. The flexible elastomeric seals shall conform to ASTM F477.
   b. The grates furnished for all surface drainage inlets shall be ductile iron and shall be made specifically for each fitting so as to provide a round bottom flange that closely matches the diameter of the surface drainage inlet. Grates for inline drains shall be capable of supporting H-10 loading for pedestrian areas. Metal used in the manufacture of the castings shall conform to ASTM A536 grade 70-50-05 for ductile iron. Grates shall be provided painted black

PART 3 - EXECUTION

3.1 COODINATION OF OTHER CONTRACTS

A. The storm sewer to be connected to is being constructed under a separate construction contract. The Contractor is required to coordinate schedule and construction installation with that Contractor before testing and tie in will be permitted.

3.2 BACKWATER VALVE INSTALLATION

A. Install horizontal-type backwater valves on headwall where indicated.

3.3 YARD DRAIN INSTALLATION

A. Install yard drains and riser extensions from sewer pipes to grades and inverts as shown on drawings.

3.4 CHANNEL DRAINAGE SYSTEM INSTALLATION

A. Install with top surfaces of components, except piping, flush with finished surface.

B. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.

C. Embed channel sections and drainage specialties in 6-inch minimum concrete around bottom and sides.

D. Fasten grates to channel sections as recommended by manufacturer.

E. Assemble channel sections with flanged or interlocking joints.

3.5 DISPOSAL OF WASTE MATERIALS

A. Stockpile, haul from site and legally dispose of waste materials, including excess excavated materials, rock, trash and debris.

B. Maintain disposal route clear, clean and free of debris.

END OF SECTION 334100